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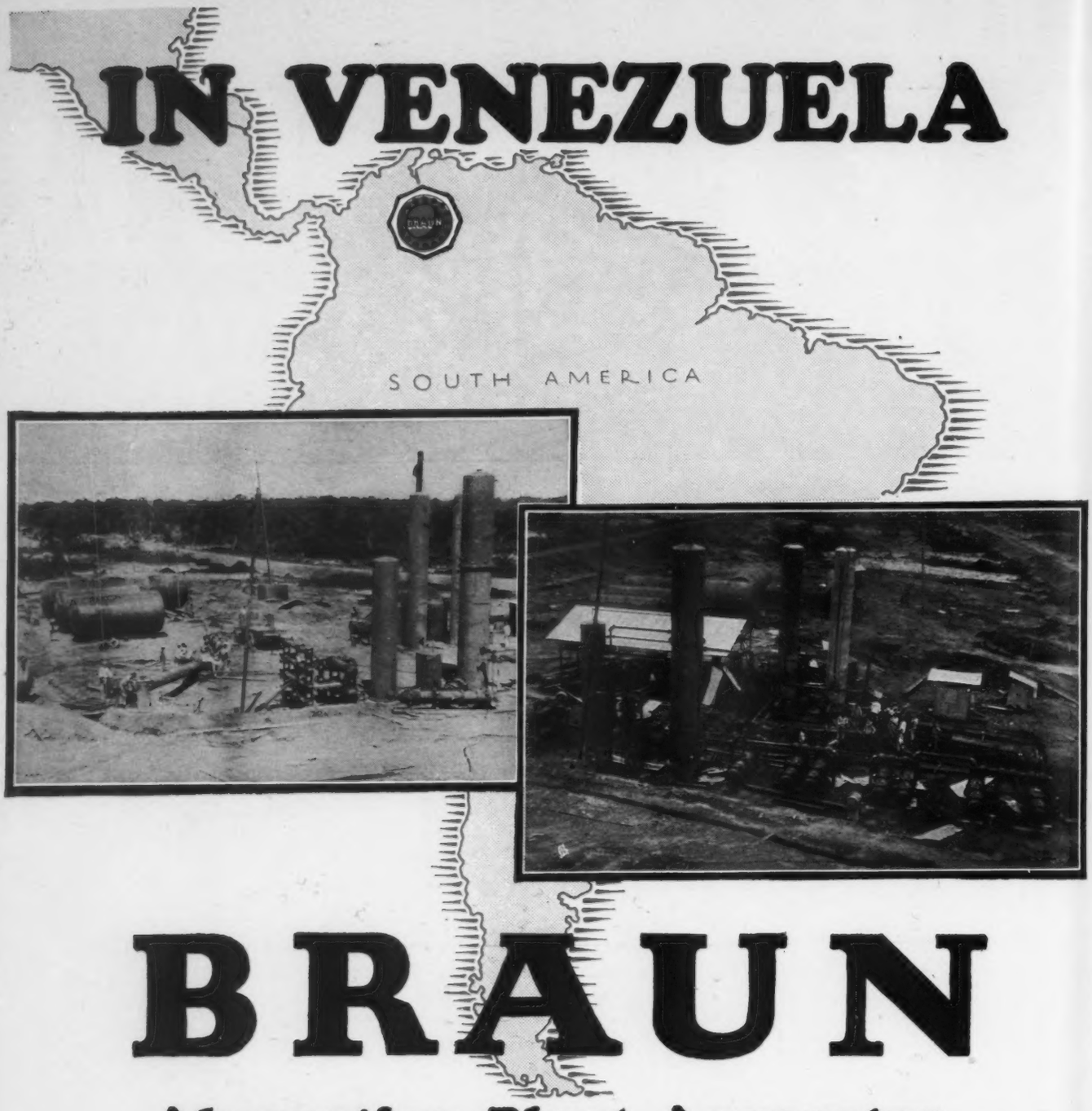

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GRADY TRIPLETT, *Editor*

GEORGE REID, *Associate Editor*

TABLE OF CONTENTS

Where Official Approval Is Not Needed 69
An Editorial by Grady Triplett

Good Year Assured for Gasoline Manufacturers 70
By H. J. Struth

Varying Load of Mixed Gasses Handled in Richfield's Seal Beach Plant .. 77
By George Reid

Comparison of Costs of Auxiliary Drives in Gasoline Plants 80
By Fred C. Loomis

Rio Grande Uses Both Absorption and Compression at Signal Hill 82

The Still and Absorption Oil 84
By A. J. L. Hutchinson

West Texas a Testing Ground for Natural Gasoline 86

Burford Plant Adapted to West Texas Crudes 88

Effective Gas Cleaning Methods Used by Gilmore Oil Company 90

Cup Grease Manufacturing Methods 93
By H. L. Kauffman

Special Precautions for Handling Sulphur Crudes at Refineries 97
By D. C. Cooper

Problems in Steam Engineering 100
By T. F. Williams

Accident Thinking 102
By Otto Peters

Natural Gasoline Association of America Meets May 21 105

Eastern Refiners Turn Attention to Gasoline 112

Cooperative Possibilities Developed in a Study of Combustion 113
By Herbert A. Ross

Pricing of Inventory 119
By H. W. Ralph

Peaks and Valleys 130
By N. H. Sanger

Abstracts of Technical Literature 140

Refinery and Gasoline Plant Activities 155

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Where Official Approval Is Not Needed

IT is too much to believe that the men, who went to Washington to ask the Federal Oil Conservation Board for approval of the American Petroleum Institute plan, heard anything except what they expected to hear. The wail of the press in general is a bit comic, for those of the petroluem industry knew what limitations had been placed on the Federal Oil Conservation Board at its formation.

What the petroleum industry heard at Washington has in no wise hampered the move of petroleum conservation. The federal government said in effect, "it is a matter for the states," which is all that could have been said and certainly all the thoughtful part of the petroleum industry expected to hear.

Fortunately there are matters of good economy and sound conservation; which do not need the approval of any official or set of officials. These are of the home type and can be worked out in a small office, with just one man present. The one man, or his board of directors, make a sound and complete unit of conservation. A decision from such a session to the effect that only gasoline sufficient to be sold at a profit will come from the plant over a period, is so sound and sensible that any official approval attached to it would seem silly.

Unfortunately there is need just now for numerous decisions of this sort. It was in September of 1928 that refinery runs in the Mid-Continent area took an upturn, when they should have been downward for the fall and winter. For the winter, they did turn downward and remain so until spring. But the excess of the one month of the fall is evident today in excessive gasoline stocks at refineries. Late April revealed a few weak spots in the Group 3 market. A mistake six months previous brought the weak spots.

There is need now for the excessive runs of last fall to be offset by curtailment in the spring. Action guided by facts, which are available is the only requirement.

In the past two years it has been the custom to belittle the curtailment efforts of the whole petroleum industry. When the number of speeches made is compared with results, the latter does not loom as a creditable finished product.

Perhaps the finest result to come from all the talk and all the meetings has been their influence on individuals. Men, knowing that conservation demanded attention, decided on bits of economy and sensible moves to prevent useless plant operation. There is more force in action of this sort by one refining company than in a dozen conferences of executives.

And at this point in the whole program of conservation, individual action still offers the surest solution of what the petroleum industry faces. With conflicting interests between large companies, different laws in different states and conditions that change frequently and rapidly, it is a task of time to expect an industry to present a concerted front. But an individual can calculate what move offers him highest business hope and then make the move.

Grady Gilbert

Good Year Assured for Gasoline Manufacturer

Refiners and natural gasoline plant operators will share large increase in motor fuel demand

By H. J. STRUTH
Staff Economist

BOTH the refiner and natural gasoline manufacturer will experience an unusually large demand for their products this year. That this summer will prove to be a gasoline season of huge proportions is evidenced by the apparent prosperity of the motor car industry and the enthusiastic optimism with which leaders of that industry regard their outlook for the current year. Concensus of opinion among motor car manufacturers indicates that at least five million motor vehicles will be produced in the United States during 1929. At this rate, it can be conservatively estimated that motor vehicle registration at the end of this year will aggregate at least 27,775,000. On this basis, the gasoline industry is assured of a domestic motor fuel demand that will aggregate about 15,540,000,000 gallons, or an increase over last year of 11.2 per cent. Some idea of the probable demand for American gasoline during the present year can be obtained from the following estimated data which shows how this demand will be divided:

	Gallons
Motor vehicles	13,340,000,000
Miscellaneous uses	2,200,000,000
Exports	2,856,000,000
Total	18,396,000,000

The fact that improvement is anticipated in the general oil situation during the present year, coupled with an unusually bright outlook for the automotive industry, furnishes a most encouraging aspect for both the refiner and natural gasoline manufacturer. There has been some improvement in the gasoline market recently and it is now confidently believed that the summer months will develop further and more marked improvement.

Natural gasoline manufacturers will undoubtedly experience a much larger demand for their product this year, as the refining industry is rapidly expanding cracking operations and will require large quantities of natural gasoline for blending motor fuel. In fact, a preliminary survey of the probable output of cracked gasoline by refineries in the United States indicates that the natural gasoline industry will be called upon to supply a minimum demand of about 1,890,000,000 gallons of natural gasoline during 1929. On the basis of the actual quantity of natural gasoline consumed by refineries last year, this represents an increase of nearly 13 per cent. In this connection, it is of particular interest to note that the natural gasoline industry has experienced a remarkable growth since 1918. This is graphically illustrated in Figure 1, which

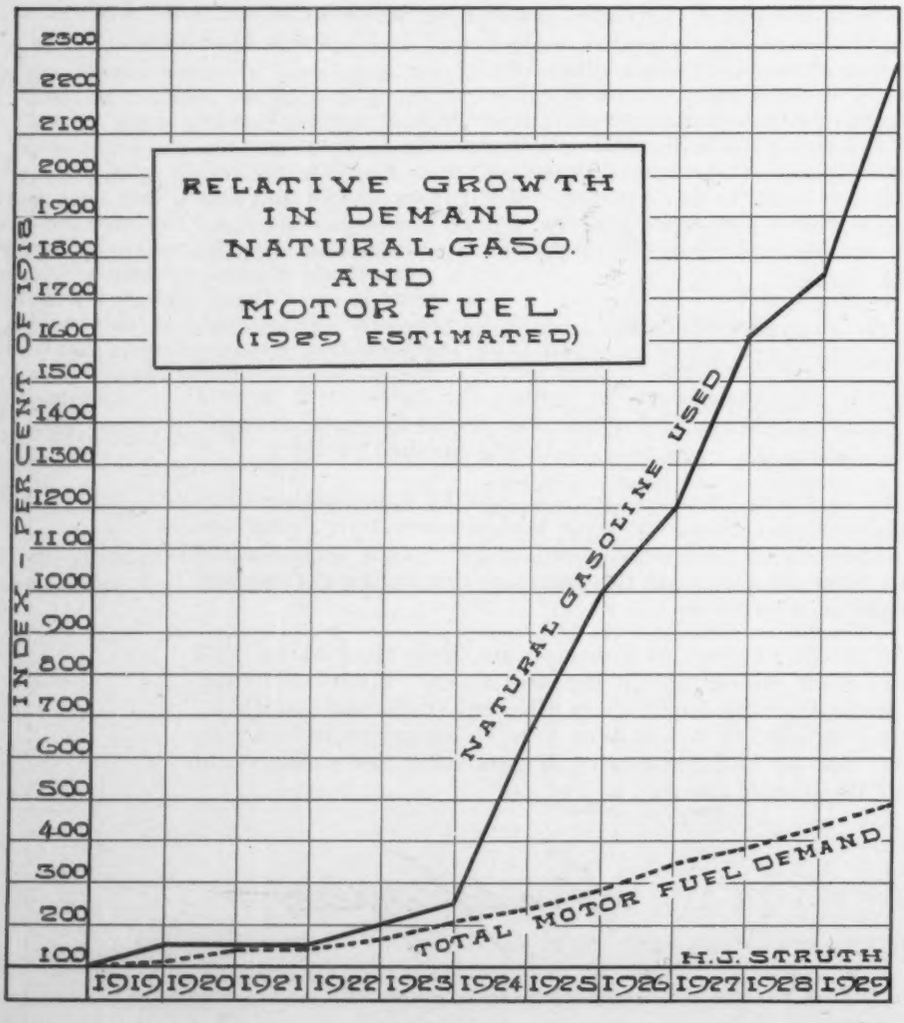


FIGURE 1

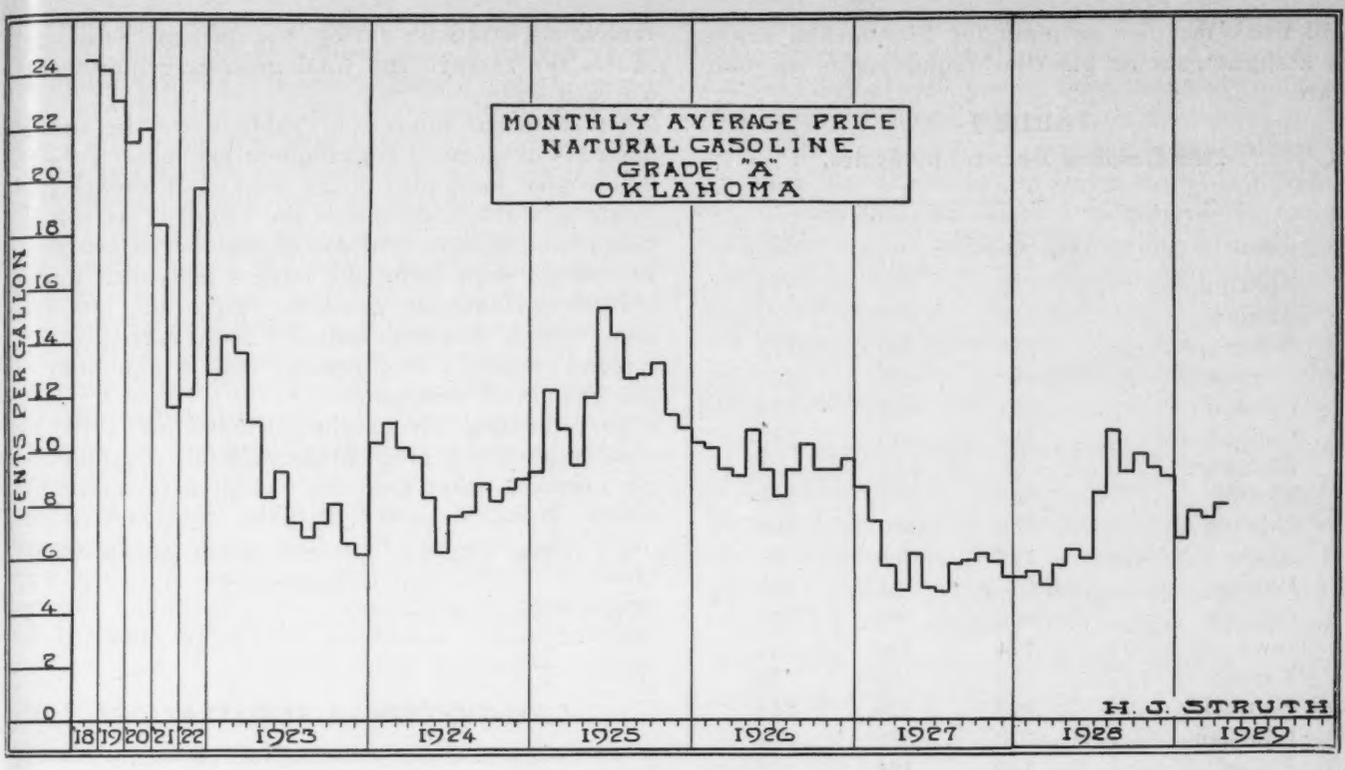


FIGURE 2

compares the relative growth of the demand for motor fuel and the quantity of natural gasoline used for blending during the last 11 years, and also the indicated status for this year. Of particular interest to the natural gasoline manufacturer is the acceleration which has accompanied the demand for natural gasoline during recent years. This, and the fact that cracking will be resorted to on a larger scale in the future, depicts a most assuring outlook for the natural gasoline industry.

PRICE IMPROVEMENT

Another favorable factor in the natural gasoline situation is the recent market action of that product. Figure 2, showing the market trend of Grade "A" natural gasoline in Oklahoma, since 1918, indicates that marked improvement has accompanied the price level for this year, compared with the same period of last year. On April 15, the market price of Grade "A" natural gasoline in Oklahoma was about eight cents, while on the same date last year, the price was 5¾ cents. This would seem to indicate that the natural gasoline manufacturer faces a considerably more profitable year. In fact, with the demand growing constantly greater, it is believed that prices will rule somewhat higher during this entire year than was experienced during 1928. This will, of course, be reflected in turn by an upward trend in the price of motor fuel, resulting in a better year for the refining industry as well. While stocks of natural gasoline have mounted at a fairly rapid rate during the first three months of this year, official statistics show that the industry's surplus on March 1 was slightly below the stock held on that date last year. This is another favorable point, in view of the fact that demand this year is considerably larger than during 1928. All of this indicates that the natural gasoline industry is rapidly coming into its own and faces a year of vastly improved conditions that may be the forerunner of a new era of prosperity. Whether this improved outlook will be realized by the natural gasoline industry, and upon its continuation, depends the ability of all concerned to maintain a state of equilibrium during the more prosperous times that are apparently ahead.

MOTOR FUEL DEMAND

Both the natural gasoline manufacturer and the refiner are interested in details of domestic motor fuel demand by states. The accompanying tabulation (Table 1) shows approximately how the huge potential gasoline demand will be distributed throughout the United States during 1929. It will be noted that California, New York, Illinois, Ohio, Texas and Pennsylvania, in the order named, lead all states in the volume of gasoline consumed by motor vehicles. In comparing the status of these states with last year's actual results, an important change is indicated. Texas, formerly occupying sixth place among the largest gasoline consumers, may succeed Pennsylvania as fifth. These two states seem to have vied for fifth place during the past two years, their total motor fuel requirements being only slightly apart. This year, however, there are indications that Texas' motor fuel demand will exceed Pennsylvania's by about 25 million gallons. It is pointed out also that improvement is anticipated in general conditions in Florida this year which will undoubtedly result in an increase in motor vehicle registrations there, and a consequent increase in the demand for gasoline. During the past two years, Florida has shown a decline in gasoline demand, as a result of severe depression there resulting in a sharp decline in motor vehicle registrations. Apparently, this year

will mark the turning point for Florida and result in a slight gain in gasoline requirements in that state.

TABLE 1.

1929 Gasoline Demand by States.

State	Average Motor Registration (Thousands)	Average Annual Gaso. Cons. (Gals.)	Total Gaso. Cons. (Mill. Gals.)
Alabama	296	605	179
Arizona	106	585	62
Arkansas	227	498	113
California	1,892	668	1,265
Colorado	301	512	154
Connecticut	336	545	183
Delaware	57	544	31
Florida	363	711	258
Georgia	336	601	202
Idaho	116	388	45
Illinois	1,685	531	895
Indiana	853	383	327
Iowa	774	434	336
Kansas	570	593	338
Kentucky	323	415	134
Louisiana	278	589	164
Maine	184	424	78
Maryland & D. C.	440	445	196
Massachusetts	768	468	360
Michigan	1,378	538	741
Minnesota	708	454	322
Mississippi	271	620	168
Missouri	753	384	382
Montana	138	456	63
Nebraska	414	502	208
Nevada	29	448	13
New Hampshire	111	522	58
New Jersey	825	413	341
New Mexico	72	542	39
New York	2,368	518	1,152
North Carolina	500	562	281
North Dakota	185	400	74
Ohio	1,733	511	885
Oklahoma	566	521	295
Oregon	259	502	130
Pennsylvania	1,755	405	710
Rhode Island	135	496	67
South Carolina	234	487	114
South Dakota	212	396	84
Tennessee	355	518	184
Texas	1,321	556	735
Utah	104	385	40
Vermont	95	358	34
Virginia	388	472	183
West Virginia	269	457	123
Wisconsin	787	468	368
Wyoming	63	508	32
Total	26,223	508	13,340
Miscellaneous Domestic Demand	...	...	2,200
Exports	...	...	2,856
Grand Total American Gasoline Demand	...		18,396

Table 1, gives complete data on probable motor vehicle registrations during the present year and shows the average and total gasoline requirements for each state.

Of particular interest in Table 1 are the annual averages of gasoline consumption per motor vehicle. These give some idea of the marked difference that exists in various sections of the country. It will be noted that Florida, because of the tourist business, is credited with being the largest individual motor vehicle consumer of gasoline. According to this data, Florida motorists consume on an average of 711 gallons annually, as compared with a minimum of 358 gallons in Vermont.

In estimating the gasoline demand for 1929, no consideration was given to the probable consumption for purposes other than the operation of motor vehicles. It will be noted that the consumption for other purposes has been estimated to aggregate about 2,200,000,000 gallons. If this quantity was proportionately distributed over the states, the individual totals would be even larger than those shown on the map and in Table 1.

CONSUMPTION VS. REGISTRATIONS

Another equally interesting fact brought out in this analysis is that the rate of gasoline consumption is exceeding the rate of motor vehicle registration in the United States. This is shown in the chart, Figure 4, the solid line representing domestic gasoline demand and the dotted line motor vehicle registration. This shows that while motor vehicle registration will have reached an index of 460 by the end of this year, gasoline demand will have exceeded the former rate of growth by 37 per cent. or a total of 497 by December 31, 1929. This is attributed to the individual increase in gasoline demand, actuated by increased mileage of improved highways, and increased utilization of the motor bus. Obviously, the motorist depends more upon his car now than ever before, and while he is getting more mileage per gallon of gasoline consumed he is also riding more miles. During the past few years, each year has shown a slight increase in the average motor vehicle consumption of gasoline, indicating that the average motorist is traveling farther each year. Then too, the increase in the number of motor bus and truck routes in the country is creating an increasingly larger demand for gasoline from that source. While this factor is as yet not a large one, it has a marked effect upon the average gasoline consumption per motor vehicle. The trend shown in the chart has been in evidence for the past two years and will no doubt continue throughout the present year, as indicated.

TABLE 2.

Gasoline Demand By Types of Motor Vehicles—1929.

	Probable Registration Dec. 31, 1929	Monthly Average Registration	Average Gasoline Consumpt. (Gals.)	Total Gasoline Consumpt. (Gals.)
Passenger Cars	22,425,000	21,352,000	338	7,220,000,000
Trucks	3,500,000	3,300,000	1,002	3,308,000,000
Taxi Cabs	1,750,000	1,475,000	1,533	2,261,000,000
Buses	100,000	96,000	5,739	551,000,000
Total	27,775,000	26,223,000	508	13,340,000,000

Table 2 presents some idea of how this year's gasoline demand will be divided among various types of motor vehicles. It will be noted that passenger cars lead the list with 7,220,000,000 gallons, with motor trucks using less than half of that amount, followed by taxi-cabs and buses, the bus being credited with the largest individual annual consumption.

Using the total indicated gasoline demand for motor vehicles alone, the writer has further analyzed this data to show the approximate monthly demand that will be experienced from this source during the present year. This anaylsis is presented in Table 3, showing the probable monthly demand, the cumulative demand to date, the cumulative percentage and the average number of gallons per motor vehicle registered.

TABLE 3.

United States Monthly Gasoline Sales Expectancy—1929.

	Month (Mill. Gals.)	Cumulative (Mill. Gals.)	Cumulative %	Avrg. Per Car (Gals.)
January	822	808	100	31
February	822	1,630	202	31
March	1,006	2,636	326	38
April	1,044	3,680	455	40
May	1,204	4,884	604	46
June	1,246	6,130	759	48
July	1,300	7,430	920	50
August	1,310	8,740	1,082	50
September	1,257	9,997	1,237	48
October	1,142	11,139	1,379	44
November	1,103	12,242	1,515	42
December	1,098	13,340	1,651	42
Totals	13,340	.....	.....	508

This data does not include the entire domestic gasoline demand, the miscellaneous demand aggregating 2,200,000,000 gallons having been purposely omitted. The averages shown, therefore, are considered to reflect with reasonable accuracy the individual use of gasoline for each month of the year. It is interesting to note that the seasonal variation is becoming less pronounced each year, indicating that all-year motoring is stabilizing the demand for gasoline. It is also of interest to note that 10 months of this year are billion gallon gasoline months, only two months, January and February, showing a demand of less than a billion gallons.

The foregoing facts serve to emphasize the unusually bright outlook that is in store for both the refiner and the natural gasoline manufacturer. The fact that each year shows a consistently larger demand for gasoline makes it evident that the ultimate future of both industries is decidedly encouraging. While both the refiner and the natural gasoline manufacturer have shared the ills of the petroleum industry, it is now believed that the turning point has arrived and that 1929 will prove to be a profitable year for these important branches. The fact cannot be overemphasized, however, that a realization of the present outlook is entirely dependent upon both industries to prevent an oversupply of gasoline throughout the balance of this year.

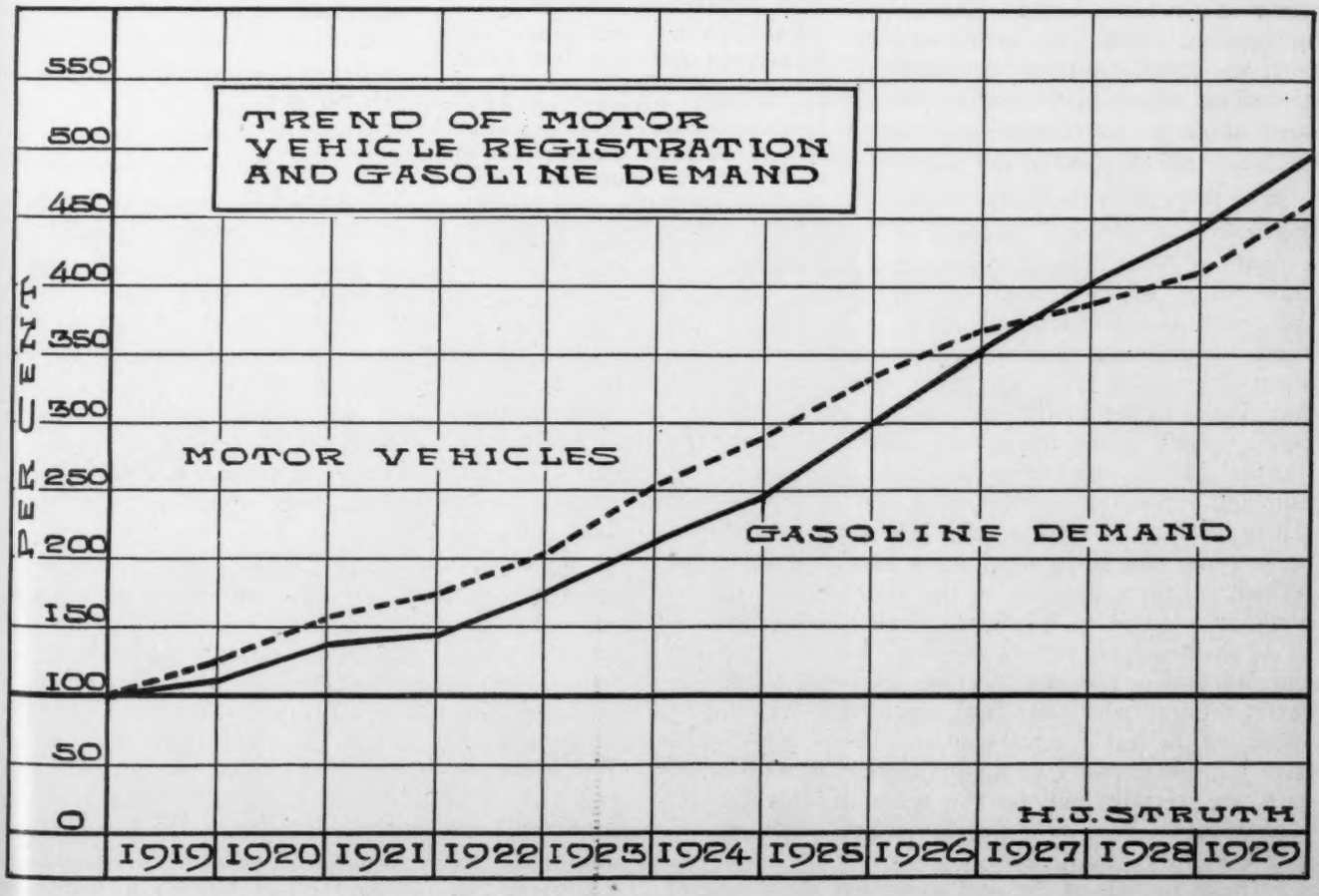


FIGURE 3

Curacao plant of the Curacaosche Petroleum Industrie Maatschappij (Royal Dutch Shell)

Shell Company's Refinery At Curacao

By ROY E. LEIGH
Staff Representative

"SHELL COMPANY'S refinery at Curacao," by Roy E. Leigh, is one of the several by this author which THE REFINER AND NATURAL GASOLINE MANUFACTURER *contemplates publishing.*

Mr. Leigh, who is a member of the editorial staff of the Gulf Publishing Company, publishers of THE OIL WEEKLY, REFINER *and* THE PETROLEUM MARKETER, *is making a tour of all fields throughout the world where oil is produced. His itinerary eventually will include many of the major refinery and gasoline plant operations in foreign countries.*

ONE sees a great change on returning to Curacao after 12 years. This sleepy little Dutch colony has come to life, and oil is the cause of it all. Since the writer saw it last, Curacao, then an unimportant little out-of-the-way port, whose only industry consisted of coaling ships and the trans-shipment of cargo, has become one of the important oil ports of the world.

More ships enter the harbor in one day now than during a fortnight or a month in 1916. The little pontoon draw-bridge which extends across the mouth of the channel which divides the business district of the community, seems about to break up under the strain of constant opening and closing to permit the entrance and exit of tankers, cargo vessels, ocean liners, and tourist ships in continuous parade, one after another, day after day. Shipping records show that from 350 to 375 tankers call in at Curacao each month. These records include ocean going tank ships which come here to load oil and refined products destined to the four corners of the earth, in addition to the Dutch Shell Company's fleet of 32 shallow-draft vessels which ply between this port and Maracaibo, bringing in crude oil for the 140,000-barrel refinery which has been constructed and enlarged during the last five years or so. These ships, which have a crude capacity of approximately 16,000 barrels each, are specially built for this trade, as larger vessels cannot safely pass over the bar which obstructs the mouth of Maracaibo harbor.

Official records of the port show that about nine of these lake tankers arrive each day, from which may be calculated that the Shell plant is now handling a total of around 144,000 barrels of crude oil per day. As only a small portion of this oil is re-exported in its crude state, the average crude through-put of the Shell refinery at Willemstad may be estimated as approximately 137,000 barrels per day.

However, customs figures indicate that the plant handled only about 103,500 barrels per day during the first nine months of 1928. Statistics covering the last quarter of the year have not yet been compiled. Records at the local customs house show that importations of crude oil totaled 4,304,078 metric tons during the period January to September, 1928, inclusive. Of this amount, 264,555 metric tons of crude oil was re-exported, leaving a balance of 4,039,523 metric tons (approximately 28,276,000 barrels) as indicating the volume of business done by the local refinery.

EXPORTS

Export statistics compiled during the same period serve further to substantiate Curacao's claim to importance in the oil industry. Customs declarations show that Curacao ships gasoline, kerosene, Diesel oil, gas oil, lubricating oil, and fuel oil, to such far distant ports as those of Egypt, Gibraltar, and the Canary Islands. Her European customers include Holland, England, Germany, France, Belgium, Portugal and Italy. Local trade embraces the West Indian islands and Latin American countries situated along the shores of the Caribbean Sea and the Gulf of Mexico, including Barbados, Trinidad, St. Vincent, Jamaica, Martinique,

Guadalupe, Haiti, Santo Domingo, Porto Rico, Cuba, Suriname, Venezuela, Colombia, Panama, and Honduras. Ranging farther afield into South America, this plant also supplies refined products to the trade in Argentine and Brazil, but leaving the Pacific Coast to be supplied from Shell sources in California and Mexico. Extensive shipments are made to the Atlantic seaboard of the United States and Canada.

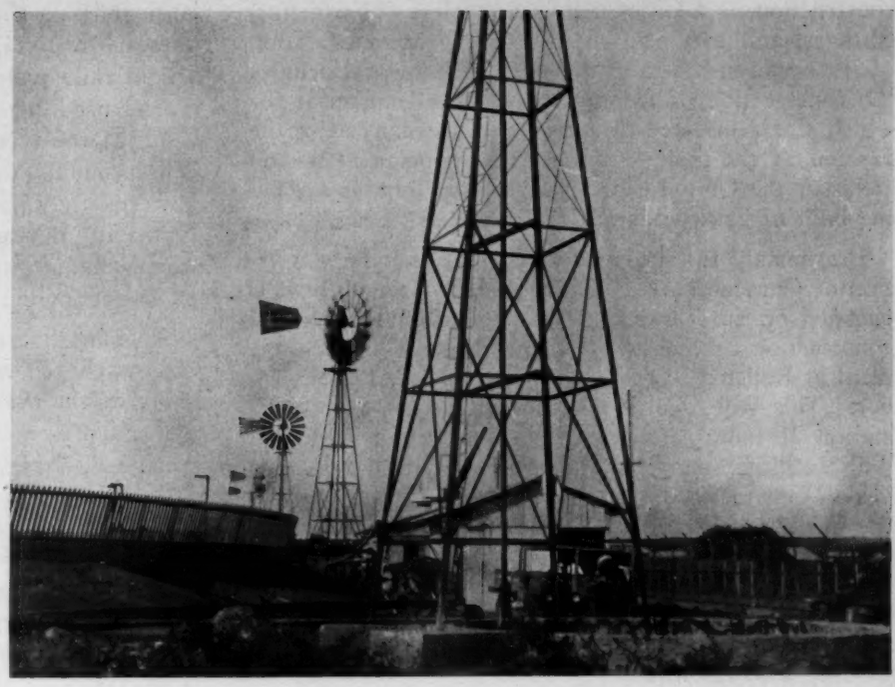
Curacao's bunker trade is especially important, as it reached the following totals during the nine months period under review:

Product	Metric Tons	Liters
Bunkers ..	408,021	.....
Diesel oil ..	.....	49,737,693
Gas oil	4,727	.....

The colony's trade in refined products, including bunkers, which also represents that of the two Shell refineries at Willemstad and Aruba, may be summarized as follows:

Gasoline

Product	Metric Tons		Liters
Curacao	719,033,092		
Aruba	8,100,000		727,133,092
Kerosene Curacao			6,414,083
Diesel oil Curacao			68,680,508
Lubricating oil Curacao			116,562,986
Gas oil Curacao		362,334	
Fuel oil Curacao	3,139,190		
Aruba	3,350,224	6,489,415	
Total		6,851,749	918,790,669



American Windmills supplying water to Curacao refinery

That the current volume of trade is far in excess of these figures is indicated on all sides, the best indications being found in the bustle and congestion of the harbor and in the increased importations of crude, as shown by the tanker movements referred to above. Furthermore, the Mexican Eagle plant at Aruba, which is now topping around 14,000 barrels of oil per day, was not completed until late in 1928; and the effect of this added capacity is not clearly shown in the foregoing figures, which cover a previous period.

The petroleum trade of the Dutch West Indies will assume further increased importance upon the completion of the Pan-American plant on the island of Aruba, nearby, which is scheduled to be put into commission in about six months. When completed, this combined topping and cracking plant (Cross process), will have a total capacity of from 80,000 to 85,000 barrels of crude oil per day.

There is also a rumor current locally to the effect that the Shell plant at Curacao, which is operated under the name of the Curacaosche Petroleum Industrie Maatschappij, will be expanded considerably during the next two or three years. Officials of the company will make no statement, but it is said that plans call for the construction of 16 more Dubbs units to be added to the six now in operation, making a total of 22 in all. Crews representing the Chicago Bridge & Iron Works are now engaged on the construction of extensive additional storage facilities; and a large force of brick masons, carpenters, and other artisans and laborers are engaged upon the

Left—J. Noorduyn, Refinery Superintendent, C. P. I. M. Plant, Curacao
Right—C. E. van der Stok, Manager, C. P. I. M., Curacao

construction of additional living quarters—apartments, cottages, and lodging houses—for the accommodation of European members of the staff. This work includes the construction of a large bachelor hall, material for which was fabricated by sections in Germany after the fashion of the ready-cut houses so popular in the oil fields of the United States. Apartment houses are being built of brick imported from Holland.

Presumably for the purpose of relieving the congestion of Curacao harbor, C. P. I. M. engineers are now engaged on surveying and grading preliminary to the construction of a large gasoline blending and storage plant at Bullen's Bay, about 10 miles west of the refinery. This will involve the construction of a pumping station, 10 miles of pipe line, gasoline storage and shipping facilities, and a loading pier to which sea-going vessels may tie up. Casing-head gasoline produced from the Caribbean Petroleum Company and Venezuelan Oil Concessions properties in the Maracaibo district of Venezuela will be blended with gasoline refined at the Curacao refinery and shipped thence to the markets of the West Indies, North America, South America, Europe, and elsewhere.

AMERICAN WINDMILLS USED IN A DUTCH PLANT

The Curacaosche Petroleum Industrie Maatschappij's arrangements for supplies of fresh water are perhaps unique in refining circles. Curacao, being a coral island only 212 miles in areal extent, has no fresh water streams and, with the exception of a few valleys where underlying gravels form reservoirs for the accumulation of storm waters, no underground waters are available. Indeed, water from these shallow sands is contaminated with salt water, being distinctly brackish to the taste; but it can be used with proper treatment.

The company has several "Water farms" on lands favorably situated for the accumulation of rain waters, which were purchased for the especial purpose of supplying the fresh water required in refining operations. On these farms about 60 water wells have been dug by hand labor to depths ranging from 40 to 60 feet. The wells are about 15 feet in diameter, and cost around 500 *gulden* ($200) completely equipped. Local contractors undertake the excavation work at an average price of 200 *gulden* ($80) per well, which leaves a balance of $120 as representing the cost of equipment on each well, including derrick, windmill, tubing, working barrel, etc. It is interesting to observe that the entire investment in water supply thus totals only about $12,000, despite adverse conditions.

One might expect to find in this service large windmills of the picturesque type used in Holland, but such is not the case. In the interest of efficiency and economy, metallic windmills of American manufacture have been adopted. Thus are the consistent trade winds of the Caribbean region harnessed to the needs of industry. These 60 wells have a capacity of around 12,000 barrels of water per day, which safely exceeds current requirements now averaging around 10,000 barrels per day.

The Curacaosche Petroleum Industrie Maatschappij's plant is a model of neatness and order. Gravelled streets and laterals serve the entire plant, which is as large and as self-contained as a good-sized village. Supplies and materials are transported about the plant over a light railway system, the tracks of which parallel the streets used for motor vehicles. The cars are small, being of the type generally used in mining operations. The locomotives are of American manufacture, and are powered by 75-horsepower four-cylinder gasoline motors. By this means, machinery and equipment are transported from the docks to the warehouses and to every part of the refinery.

In going through the Curacao plant, one is gratified to observe that American manufacturers contributed a fair share of the materials of which it is constructed. This plant is different from American refineries in that it contains boilers, pumps, engines, electric generators, etc., manufactured in Holland, Germany, and England; but the pipe, valves, fittings, forgings, gasoline locomotives, gasoline hoisting motors, windmills, storage tanks, fire-protection apparatus, and automotive equipment are all of American manufacture. The Dubbs cracking units are also distinctly American in design and in materials.

The Curacaosche Petroleum Industrie Mattschappij's plant is manned almost entirely by Europeans, chiefly Hollanders with a few Germans, of whom about 600 are now on the salaried pay roll. As neither Holland nor Germany had an extensive refining industry, it is necessary to bring out young men under long-term contracts (four years) and develop them into still-men, firemen, etc., by instruction on the ground. Although skilled workmen employed here receive wages substantially lower than those in effect in America, they nevertheless compare favorably with European rates of pay; and the workmen appear to be contented and happy. Certain it is that the company spares no expense and overlooks no opportunity to promote their comfort and well-being.

Recreation facilities at Curacao include club rooms, tennis courts, swimming pools, bathing beaches, a rifle range, a movie theatre, dances and bus survice from the plant to the town, in addition to which there is a well-equipped and well-staffed hospital for the treatment of the sick and ailing, both from the fields in Venezuela and from the refineries at Curacao and Aruba. The Caribbean Petroleum Company, one of the Venezuelan subsidiaries of the Shell group, maintains a rest camp and holiday station at Piscadero Bay, near Willemstad. Employees are sent out from the bad lands of Venezuela to the more salubrious climate of Curacao for rest and recuperation at yearly intervals, or oftener if required by the health conditions of the individuals. Convalescent patients are also sent to this station upon being discharged from the company hospital. The camp is situated on the sea-shore, where it receives the full benefit of cooling sea-breezes; and consists of a commodious club building surrounded by apartments for the accommodation of families and sleeping quarters for single men. Tennis, bathing, boating, fishing and other recreational facilities are provided, in addition to excellent billiard tables and other indoor features.

View of five absorbers handling gas of varying gasoline content and with variable loads. Note safety guard rails around all valves and valve pits

Varying Load of Mixed Gases Handled In Richfield Seal Beach Plant

By GEORGE REID
Associate Editor

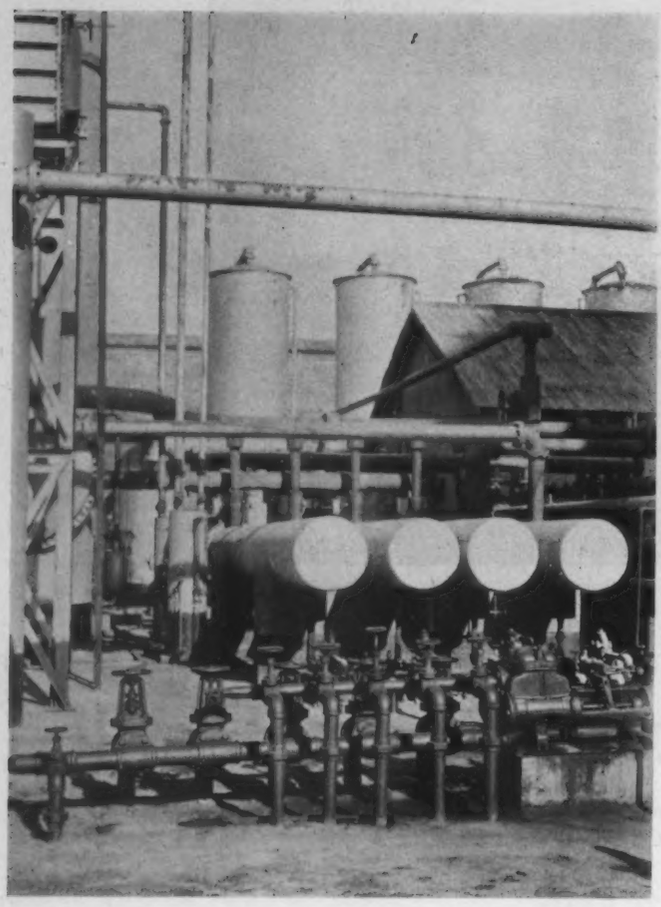
RICHFIELD Oil Company's Seal Beach natural gasoline plant, No. 14, as originally installed consisted of only absorption equipment operating on field pressure. With the subsequent development of the field and the employment of gas lift system of production by field operators, it became necessary to more than double plant facilities. Two absorbers were increased to five. An additional cooling tower was required, more boilers, and additional preheaters, exchangers and other equipment. With the adoption of gas lift methods by producers it became necessary to install the booster plant, consisting of eight machines, to pump gas into the plant from the Bixby and Sellover sides of the field.

At this plant exists a peculiar set of conditions. First, construction of the plant was difficult, as it is located on an old salt marsh and sand bed. The Seal Beach field is located but a few hundred yards from the ocean front and practically all of it lies in the salt flats. This required roads of special construction into the field to all of the wells and plants. Each piece of equipment had to be placed on deeply driven piling. For example, at the Richfield plant there are eight piling under each machine in the compression plant. Roadways consist of dikes of decomposed granite. The plant yard at the gasolone plant consists of a 12-inch layer of decomposed granite, which has the advantage of settling hard and firm and does not wash.

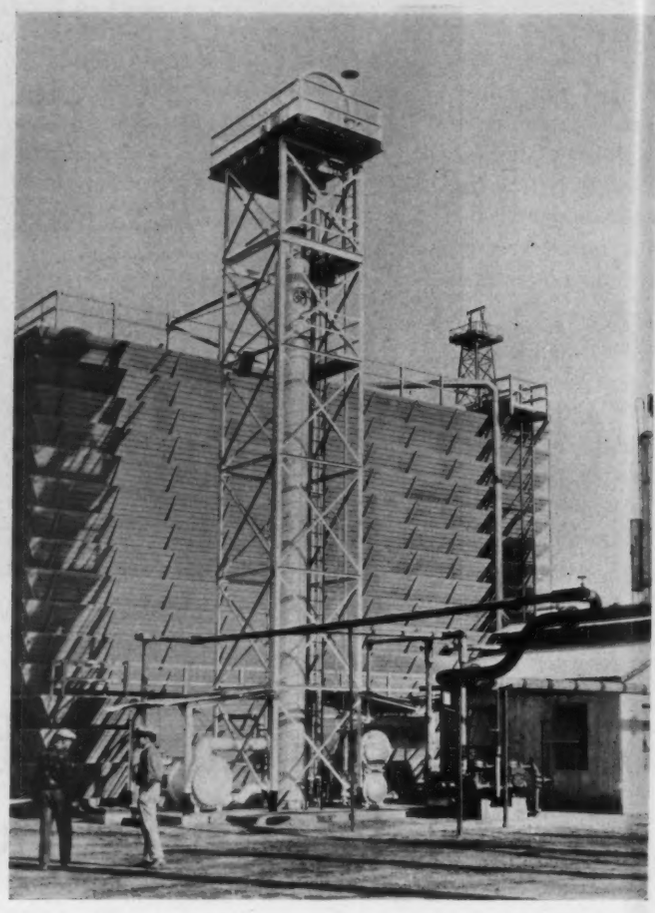
The unusual conditions existing so far as plant operation is concerned lies in the fact that this plant is handling two types of gas in varying proportions and of varying characteristics. With 33 wells in the field from which the plant was getting its gas at the time of the writer's visit about 40 per cent. of the gas yield was recycled through gas lift systems, and 60 per cent. was formation gas, or natural production. Eleven wells, with two more drilling, were on the Sellover side of the field, and 16 wells were producing on the Bixby side. Four wells on the latter side were off production. A condition of this kind means that not only does the type of gas being treated vary at the plant, but also the gasoline content of the recycled gas changes, as well as the proportion of formation gas to recycled gas.

The recycled gas employed in lift systems has a gasoline content of 1.65 gallons and less, per thousand cubic feet. Formation gas averages three and one-half gallons per thousand. The range of change in proportion of formation gas to recycled gas runs from 40 per cent. to 60 per cent. of either type, depending upon the number of wells shut down or operating on gas lift, and the number of new wells producing formation gas.

The compression plant boosts the gas from six pounds pressure to 40 pounds. Plant throughput at the time of the writer's visit was 20 to 21 million cubic feet daily. The absorbers handle fluctuations through automatic controls. Oil to gas ratio is naturally affected as is saturation, but no attempt is made to change rate of flow of oil as the proportional volumes of gas changes or the gasoline content increases or decreases. The plant is tested by the control laboratory three times per week,



Exchanger and preheater equipment is hooked-up in parallel. Efficiency of each unit is checked by temperature rise



High pressure rectifying equipment at Richfield's Seal Beach plant, showing assembly and construction details

because of these changing conditions, as a means of determining average efficiency. It is seldom that advance notice can be secured from the producing company so that changes may be anticipated. Passing through the plant the gas is distributed through the five absorbers in equal volumes by means of block valves. Orifice plates are placed in the inlet lines to absorbers to get a little pressure drop at this point. Gas is returned to the producing company's lines at 32 pounds pressure.

EXCHANGER, PREHEATERS IN PARALLEL

With the increase in capacity and subsequent installation of additional equipment and increase in oil circulation the preheaters and exchangers were increased to four of each. Some changes were indicated in the oil circulating system to secure high oil rates. Two Worthington 10 x 7 x 10 pumps are used on each oil circuit—the fat and lean. Lean oil is taken from the heat exchangers, discharged through the cooling coils in the Campbell cooling tower, then into the six Griscom-Russell sections in the Flour tower. In this new tower there are 14 G-R sections for gas cooling and six for cooling water passed over the engines and compressors, in closed system. From the second cooling tower the lean oil passes to the top of the absorbers. Oil rate is controlled at the absorbers by means of orifice plates placed in the inlet lines. Oil is measured to the absorption system through a differential meter, but is not metered to the individual absorbers.

Fat oil is picked up by two more pumps working together, at the bottom of the absorber, passed through the heat exchangers and through the preheaters. There are four exchangers and four preheaters hooked-up in parallel instead of in series. Through the parallel arrangement of this equipment the oil circulation is increased and the pressure on the circulating pumps greatly decreased. In both the case of the four exchangers and four preheaters, they are so manifolded that any one of them may be removed from service for cleaning or repairs without interfering with plant operation seriously. In such installation as this where two pumps are employed in the circulation of both lean and fat oil there is no necessity of providing stand-by equipment, since one pump alone can temporarily handle the load in the event minor repairs are needed.

Leaving the preheaters the fat oil at a temperature of about 336°F. passes into the lower section of the Ereco distillation unit. Oil outlet temperature as it passes back into the preheaters is reported at 346°F. In the preheater section of the still agitating steam is used. Vapors pass upward through the still column countercurrent to descending refluxed gasoline. The overhead vapors from the top of the still pass downward through the vapor line into a Southwestern primary condenser, which is regulated in its work of partial condensation by rate control of the water passing through the condenser. Vapors and condensate from the condenser leave the bottom and flow into a vertical reflux leg or small accumulator. Practically all of the water is re-

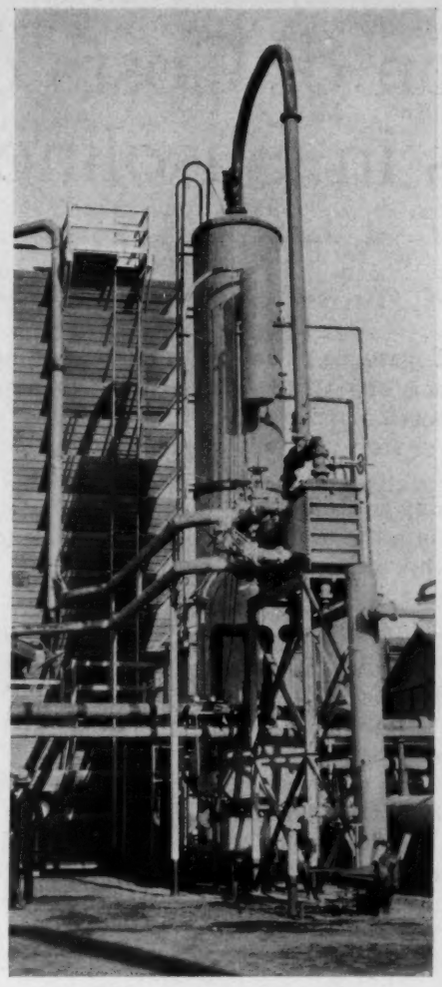
moved in the still through the usual type of water legs peculiar to this type of equipment.

If a small quantity of water arrives at the vertical tank either from the still or from leaks in the condenser, this settles to the bottom of the tank and is removed through traps. The tank is actually a reflux accumulator inserted in the gasoline rundown line where the heavier gasoline condensed in the primary condenser accumulates. A liquid level controller permits gasoline to flow from a point near the bottom of the reflux leg to a rate controlled pump. This pump discharges the reflux back to the top of the still. Automatic temperature controllers regulate the reflux in control of the temperature at the top of the still.

That portion of the vapors which is not condensed in the primary condenser and the excess gasoline over-flowing from the reflux leg, flow into the coils in the Campbell tower for further cooling and condensation. In this manner the still operation is simple and automatic and permits much flexibility of operation, which is necessarily of much importance where the plant is operating on gases bearing varying percentages of gasoline.

RECTIFIER COLUMN

All of the gasoline plant make is taken from run down storage and charged to the high pressure rectifier. This installation operates at 190 pounds pressure. It was installed after consideration of the two prevalent types of stabilizers of rectifying columns which are becoming extensively employed. In the high pressure installation live steam must be used in the heating section or reboiler, but the top of the column may be cooled at atmospheric temperature. In the low pressure types of rectifiers which call for lower temperatures, bottom temperatures may be secured with exhaust steam when operating at pressures of 10 to 15 pounds, but the top requires cooling by refrigeration — with its subsequent troubles from freezing unless the gasoline is thoroughly dewatered. The problem is one of weighing the cost of live steam against dewatering and refrigeration or recompression. In this installation, operating at high pressure live steam is employed in the reboiler section, with atmospheric cooling at the top. Raw feed enters the stabilizer at about half way up the column at the twelfth tray. It then flows downward through the column against rising vapors from the reboiler section, which is located near the base of the tower. The gasoline, partially denuded of it slighter constituents flows from the bottom of the column into the reboiler, which is held at 250°F. temperature. Vapors evolved in the reboiler flows upward and back into the tower at a point just under the first tray.

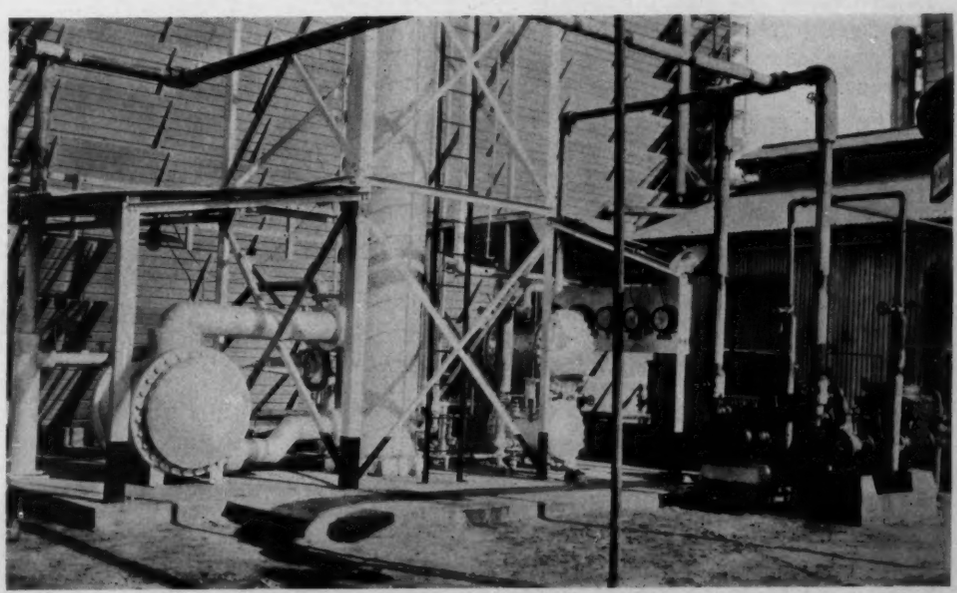


Distillation equipment at Richfield Oil Company's Seal Beach plant. Reflux leg with level control is shown in right foreground

The overhead stream of vapors passes into a condenser section mounted at the top of the column. Condensate derived from the cooling at this point is conducted back into the tower to flow downward over the series of trays in the upper section, to wash the ascending vapors.

Gasoline accumulating in the reboiler section at the bottom of the column is withdrawn through control by liquid level regulator devices and passed into the heat exchanger to preheat the incoming raw charging stock. It is then cooled and taken to finished storage.

Those vapors not condensed in the cooling equipment at the tower top are carried away for use as fuel under the boilers. Finished gasoline produced at the plant is taken by pipe line to the company's Watson and Haynes refinery for blending.



Close up of equipment assembled at base of high pressure fractionating column. Reboiler at left, exchangers at right and control board

Comparison of Costs of Auxiliary Drives in Gasoline Plants

By FRED C. LOOMIS*
Engineer of Design, Standard Gasoline Company

AUXILIARY power in natural gasoline plants is used chiefly for the pumping of water, absorption oil and gasoline, therefore this discussion of the various types will deal with pumping units.

The most common types of pumping units are the direct acting reciprocating steam pump, the non-condensing steam turbine driven pump, the electric motor driven pump and the gas engine driven pump.

The direct acting steam pump is hard to equal in the essential qualities of flexibility, simplicity and reliability, when a proper selection is made. It is, however, a very inefficient machine thermally.

The steam turbine and centrifugal pump are well suited to each other and combine to form an efficient, flexible compact unit and development of the turbine has made this type of drive quite economical. The economy is most apparent in larger sizes and when using higher steam pressures. The steam turbine gives a great factor of safety for overloads and is flexible in that its speed can be easily altered by adjusting the governor.

The electric motor is the simplest driver for both centrifugal and power-driven displacement pumps. The motor must be selected properly for the pump drive, because it will not stand a continuous overload without deteriorating and if selected too large, power will be paid for that is not used:—this of course only where power is purchased on motor rating. The extreme simplicity and absence of fire hazard make the squirrel-cage motor most desirable for gasoline plant work, although the slip-ring motor may be necessary from the standpoint of low starting current.

The gas engine, chiefly due to its low operating cost is a very desirable driver. A gas engine should be so selected that its power demand does not exceed 90 per cent. of its rated power. For gasoline plant auxiliary work it is probably more economical in the long run not to exceed an 80 per cent. load factor. Gas engines are not very flexible as to speed variations, but are very adaptable to various types of pump drives, it being feasible to direct connect through geared transmissions, to drive lineshafts from which any combination of pumps may be belted, or to drive pumps directly from engine by belts.

COMPARISONS DIFFICULT

Any comparison of these types of drivers, with a view to selecting the type with the greatest overall economy, involves more than the mathematically computed cost of operation summated from the items of fuel, lubricating oil, water, interest, repairs, operating labor, etc. There are irreducible items such as standby charge, salvage value, training and experience of the operating organization with the various types, etc.

Even the more or less tangible items attributing to cost are not definitely known in many cases. How much does our fuel gas cost? We may know today, but will we know what it will be worth in the same field in a year or even six months from now? What will be the repair costs of a particular installation?—and by this I mean the material and labor costs necessary to maintain the equipment in 100 per cent. condition? We may have accurate records of costs for some type of drivers, but we do not know how efficient our operating and repair crews will be with a different type.

There is so much data, influencing a choice, which cannot be reduced to dollars and cents and so much that varies with our ever changing conditions that it is impossible to generalize and definitely say that any one type is the most economical.

The data and assumptions on which the comparison of the types of drivers above mentioned is based are taken as far as possible from actual installations and operating records, and an attempt has been made to make the figure constitute an average. There are undoubtedly some plants operating with greater economy than here indicated, but it is not always possible to maintain the conditions that give the auxiliary equipment its greatest economy.

PREMISES OF CALCULATION

The costs in the table are for one brake horsepower for one month delivered by the power part of the pumping units, and are based on the following premises.

The units on which the costs are based are of a size that would deliver about 60 B.H.P.

Operating labor has been omitted because it would probably be about equal for all types.

Gas fuel has been taken as costing eight cents per 1000 cubic feet. Electric current at one cent per K.W. hour. Lubricating oil is taken as costing 30 cents per gallon; steam cylinder oil at 40 cents per gallon.

Water is taken as costing one-half cent per barrel.

Interest on investment is taken as 6 per cent. annually on complete installation cost.

Depreciation is based on a life of 15 years or 6 2/3 per cent. annually. This might better be called an

*Read before California Natural Gasoline Association, April 11, 1929.

obsolecence figure since our repair costs are considered as maintaining the unit in first class shape.

The installation costs for the direct acting steam pumps and turbines includes the necessary boiler plant, piping, foundations, housing, etc. For the electric motor driven pumps it includes foundation, housing, necessary switches and wiring, but does not include the transformers or pole line to property. For the gas engine unit it includes foundations, piping, necessary cooling systems, air starting system, etc.

The fuel costs are based on the steam consumptions shown, with the boiler plant considered as using 1.5 M cubic feet of gas for every 1000 pounds of steam generated.

The costs for the steam units are based on no utilization of the exhaust steam.

In order to arrive at a cost figure for steam units when exhaust steam is used in the strippers, several typical plants were checked over to determine the average ratio of steam required in strippers for efficient stripping, to the amount of oil circulated.

Around 160 pounds of steam per 1000 gallons of oil circulated should be sufficient.

Also the ratio of operating auxiliary B.H.P. to oil circulation was averaged and found to run around .22 B.H.P. for every 1000 gallons of oil circulated per day.

Using these figures we see that an absorption plant with an oil circulation of 4500 gallons per day would require total auxiliary equipment developing one B.H.P. per hour, and would require the use of 720 pounds of steam per day in the strippers for denuding this amount of oil. This amounts to 30 pounds of steam per hour per B.H.P. of auxiliaries that can be economically utilized from the exhaust.

The increased steam consumption of direct acting pumps and even steam turbines per B.H.P. hour is generally more than this amount when steam pressures of around 125 pounds gauge and back pressures of 30 pound gauge are used. Therefore under these conditions it would be uneconomical to operate the total auxiliary installation with a back pressure on exhaust so that the steam might be used for distillation. Steam economy would be noted, however, by utilizing the exhust from enough of the pumps to meet stripper requirements.

LARGER UNITS ECONOMICAL

With larger units, say 150 to 200 B.H.P. and steam pressures of 200 pounds or more, marked economics are possible with turbine drive.

From this comparison the following more or less general conclusion may be drawn.

The gas engine drive is desirable in permanent, long-lived installations because of its low operating cost. It is desirable where gas is valuable because of its low fuel consumption. It probably requires a better trained and more experienced operating organization than the other types if its greatest economy is to be realized.

The steam turbine drive is desirable if fuel cost is low. It is desirable in large installations using high steam pressures, for the economy is much greater under those conditions. It is desirable if the use of exhaust steam is economical and desirable.

The electric motor drive is desirable for temporary or uncertain installations, for its low first cost and high salvage value will offset its relatively high operating cost. If gas is very valuable the electric motor can often equal the other types in operating cost. The reliability of the power service must be considered.

Direct acting steam pumps are desirable if fuel cost is negligible and desired capacities are uncertain. Their simplicity, reliability and capacity range make them appreciated if conditions are unsettled and if the operating organization is inexperienced.

Combinations of types is desirable in many cases and will show good overall economics. For instance the use of gas engine or turbine driven units to take care of the known permanent or long-lived capacity with electric motor or steam pumps to handle the excess loads and take care of the peak or flush periods. Or the use of gas engine units for the steady loads and turbine or steam pumps for the varying loads.

In conclusion it must again be said that it is practically impossible to make any general statements as to the correct auxiliary installation. This discussion may indicate, however, some of the points to be considered when planning such installations.

Comparison of Costs of Auxiliary Drives in Gasoline Plants

	Reciprocating Steam Pump Assumed Steam Consumption 112 lbs. H.P. hr.	Steam Turbine Assumed Steam Consumption 50 lbs. B.H.P. hr.	Elect. Motor Assumed as 90% Eff.	Gas Engine 80% Load Factor Assumed Fuel Consumpt. 14 cu. ft. per B.H.P. Hour.
Installation cost per B.H.P.	$150.00	$138.00	$50.00	$170.00
Fuel—				
Gas at 8 cents per M	9.50	3.90		.85
Elect. 1 ct. per K.W. hr.			6.00	
Oil, 30 cents gallon		.02	.02	.30
Cylinder Oil, 40 cts. gal.	.10			
Water, ½ ct. per bbl.	1.13	.46		.10
Interest,, 6 per cent	.75	.69	.25	.85
Repairs and Supplies	1.00	.75	.10	1.00
Depreciation on basis of 15 years life	.83	.77	.27	.94
Total operating cost per B.H.P. per month	13.31	6.59	6.64	4.04

Rio Grande Uses Both Absorption and Compression at Signal Hill

WITH the development of the deeper oil sand in the Signal Hill field, the Rio Grande Oil Company, which owns and operates the Reservoir Hill Gasoline Company absorption plant, has found it necessary to expand the plant facilities to take care of three times the volume of gas that was available two years ago.

Where 5,000,000 cubic feet daily was the operating total in 1926, the company now has 15,000,000 cubic feet per day due to the increased use of the gas lift on its own leases as well as the development of this property in the deep sand production. The average gasoline content from the gas is 1.4 gallons per thousand feet. Gas from the shallow producers is handled through the usual type of booster station, which after recently being enlarged, consists of five 165-horsepower direct connect Clark engines, 16 x 17 x 20. Formerly three engines and compressor were sufficient at this point. That portion of the gas which comes from wells not producing from the deeper zone is handled through the compression plant and through two Campbell type absorbers.

Gas from deeper zone producers is handled direct from the field through scrubbers and into a separate Oil Froth absorber. These absorbers are part of the second of the Campbell plants to be installed on the West Coast and have been in operation since May, 1926. So long as field pressure is sufficient the gas from deep sand producers will not be compressed. Much of the plant's residue gas is employed by the company in gas lift work and is recycled from plant to well continuously.

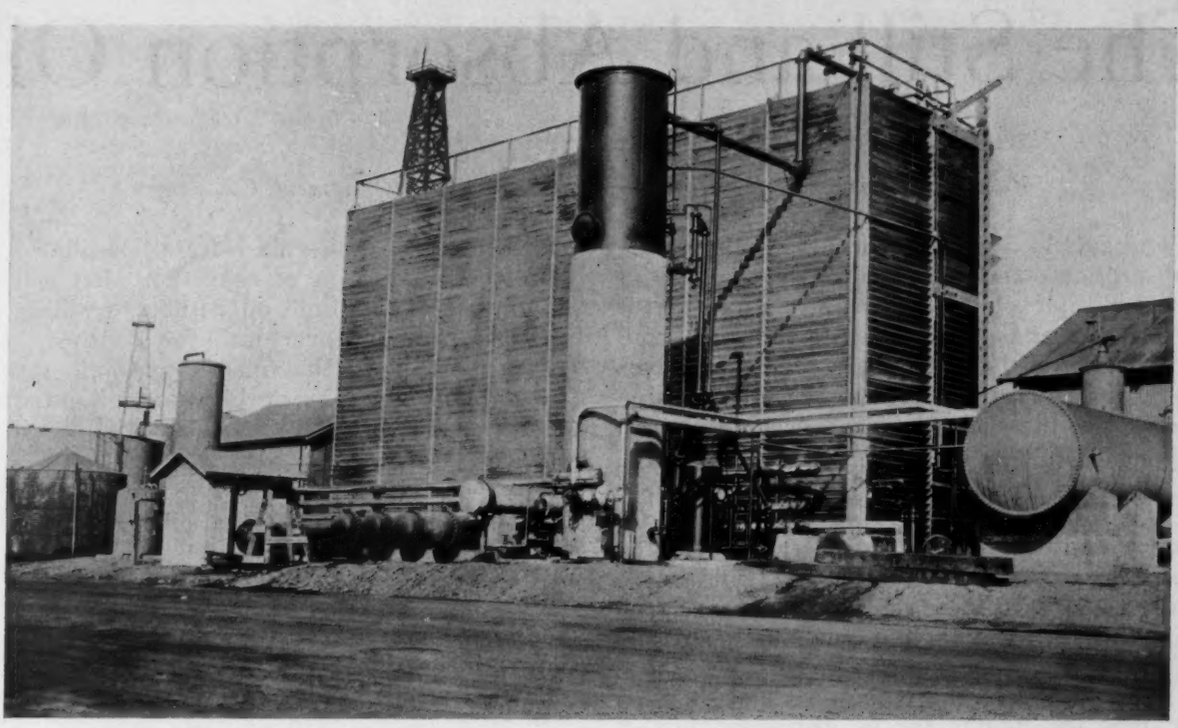
An unusual and interesting feature is found in connection with the first scrubber, though gas is cleaned before entering the compression room, in that this scrubber tank is provided with an alarm device. Occasionally the gas trap in the field may fail to function properly and the incoming gas will carry with it a certain amount of oil. For this reason the scrubber tanks are installed in the gasoline plant. When such a condition arises at this plant and the scrubber fills with oil to a certain low level, the increasing or rising oil level actuates a float device, causing it to rise inside of the scrubber which, in turn, causes a valve to open, permitting high pressure gas to escape and blow a shrill whistle. The device installed for this work is a Nielan-Abbey float level controller. The alarm calls the operator's attention to the condition of the scrubber and when the alarm is given the oil is well below the actual danger line so that sufficient time is allowed the operator to dump the scrubber free of accumulated oil and leave it in readiness for another "slug" of oil.

STRIPPER STILL

Compressed gas leaving the compressor plant is conducted to cooling coils and again scrubbed. Cooling causes the condensation of a small quantity of gasoline which is accumulated in a small tank. This tank is really a small still, in the bottom of which is a closed steam coil and an open steam spider device. Steam is used in sufficient quantity to distill the small quantity of condensed gasoline, the vapor being conducted to the top of the main still and combined with the regular plant production of gasoline. This stripper still is home-made. It prevents the contamination of the regular plant production with any off color gasoline and effects the blending of the compression gasoline with the absorption gasoline in the vapor state. Residues accumulating in the bottom of the small still are periodically drained off.

Home-made "stripper" still for distillation of small amounts of compression gasoline from the cooled gas leaving the compressor plant. Vapors are conducted into the top of the main still

Two absorbers handle the gas from the compression plant, the flow being equalized to the towers by means of block valves on the intake lines. Manometers are installed on each gas intake line near the absorber, which act as indicators of the volume of gas passing into the towers. The manometers are suspended on the wall of the small



Distillation equipment at Rio Grande Oil Company's Long Beach, California, plant. The dephlegmator is of the direct contact type, water to gasoline vapors

control room built in the pump house instead of being placed outside and exposed to the weather.

The construction of corrugated iron buildings in which are housed the gasoline accumulator tanks, pump house, control room and office, and the absorbers, gives the plant an appearance different from the usual installation and protects the equipment from the weather. Also the operators are more comfortable and can operate the entire plant, except the boilers, which are automatically controlled, without leaving the one roof.

Four Worthington 10 x 6 x 10 pumps are used to circulate absorption oil through the towers, exchangers, preheater, still and coils. Two pumps operating together circulate fat oil, and the other two pumps operating together handle the lean oil. With such a system, auxiliary equipment is unnecessary, as one pump can handle the plant temporarily in the event of the other needing small repairs.

OIL LEVEL CONTROL

Oil level in the absorbers is controlled by four-inch Fisher float regulators. This device controls the rate of speed of the steam pumps by means of steel wire extendings, which are actuated by the movement of the regulator lever, opening or closing the steam valve on the pumps. Rich oil from the absorbers passes through a series of five Heat Transfer Products type of exchangers, and through a preheater of the same type.

From the preheater the oil passes into the Barton still. In the bottom section of the still is incorporated a Griscom-Russel internal heater. Vapors liberated in the still bottom pass upward through a series of bubble trays counter-current to reflux which overflows from the dephlegmator section above, and the downward flowing rich oil which is injected at the top of the stripper section. Lean oil passes out of the bottom of the still. A liquid level control device regulates the flow of oil from still to preheater, exchangers, cooling coils, and to the lean oil pump.

The Barton still incorporates the direct contact type of dephlegmator in a separate section at the top. This means that the gasoline vapors and the steam employed in distillation pass upward and out of the stripper section through large tubes into the upper section where it comes in direct contact with water. The volume of water is regulated to secure the desired results of temperature which will cause the condensation of the steam and the reflux gasoline. Four trays are installed in the dephlegmator section. The water level is held at a predetermined height by means of a water sealing leg in the overflow line. As the water accumulates in the bottom of the dephlegmator it overflows and passes down through a small line to a small water tank. A liquid level controller regulates the rate at which a pump takes water from the water accumulator. This pump discharges the water through a cooling coil and back into the top of the dephlegmator section. Distillation steam is condensed in the dephlegmator and taken into the water system, and removed to the cooling tower pit where too much water accumulates in the system.

Reflux in the dephlegmator accumulates below the bottom tray and on top of the water level. It overflows into down pipes and continuously flows back into the still or stripper section below. Gasoline vapors pass from the top of the dephlegmator section and to condenser coils and storage.

The item of special interest on storage tanks is the safety guards around the ladders. The steel framework of the safety guard is constructed of material heavy enough to support the weight of the gager when it is necessary for him to stand or sit upon the bracing, or in the event of a fall, it is sturdy enough to bear his weight and prevent serious injury. The company superintendent states that all tanks having ladders on the company's property have been equipped with safety guards of similar type. A concrete fire wall is an additional safety feature. Vapors from these tanks are retreated through the plants in the tail gas recovery system.

The Still and Absorption Oil

By A. J. L. HUTCHINSON

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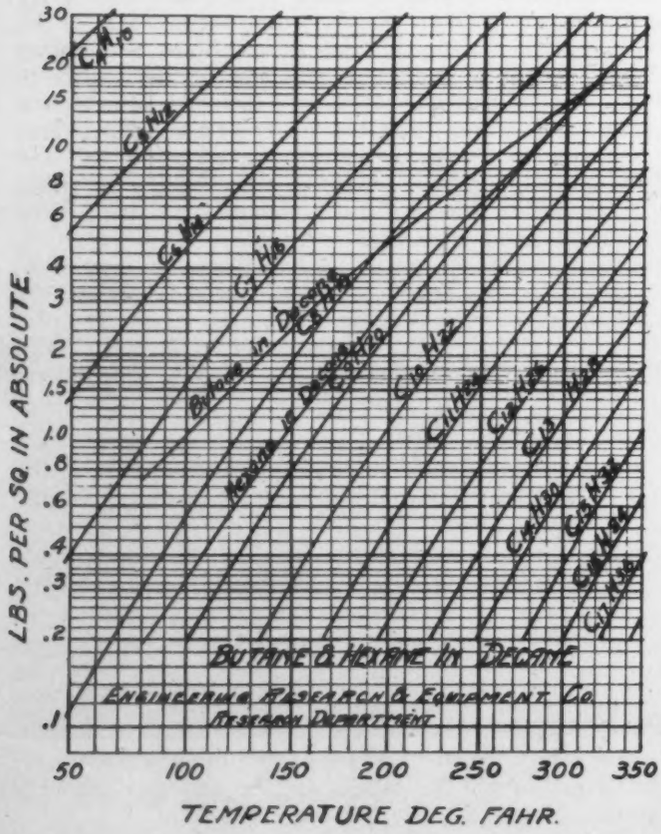
A MATERIAL improvement in natural gasoline absorption plants has been the development of the multiple plate absorber. In this type of absorber the oil and gas approach equilibrium conditions much closer than they do in the old type baffle towers; therefore, the importance of the condition of the lean oil to these absorbers is exceedingly great.

The primary function of a still is to remove the dissolved gasoline from the oil. This seems to be a relatively simple thing to do. However, there is another condition to be met that considerably alters the problem. This condition is that there should be no oil distilled over with the gasoline. If we use an oil having a sufficiently high initial boiling point and end point, this condition is not very difficult to meet. It has been shown in the laboratory and in plant practice that the lighter the oil (provided the oil does not contain large amounts of the same constituents as the gas) the better absorption medium it becomes.

Lighter and lighter oils are being used for absorption, and at the present time a number of plants are using oil with an initial boiling point of 325°F and an end point of 425°F. This is an excellent absorbing medium, giving very low pressure drops through heat exchangers and cooling coils and showing very high heat transfer values in this equipment.

The type of still as described by Mr. Ragatz in his talk before the California Natural Gasoline Association is the only type of equipment that will permit of the use of this light oil without distilling an appreciable amount over into the finished gasoline. Absorption oil in the finished gasoline makes the natural gasoline a poor blending product for the refiner and reduces the efficiency of the oil in the absorber.



The absorption and distillation processes are vapor pressure phenomona. This statement translated to the absorber means that for high extraction efficiency, the vapor pressure of the lean oil entering the absorber must be low. The minimum quantity of any constituent in the discharge gas from an absorber is determined by its vapor pressure in solution in the oil. The partial pressure of any constituent in the gas can never be less than its vapor pressure in the oil. Heavier constituents of gasoline can be present to the extent of several per cent. in the lean oil without showing a measurable vapor pressure, while a small percentage of the lighter constituents would show a high vapor pressure. A saturation test of the lean oil may be very misleading unless it is known just what constituents remain in the oil.

It then follows that another limitation is placed on the still. The still should remove completely the lighter members of the gasoline series although it may actually leave several per cent of the heavier constituents in the oil.

By taking hypothetical cases that can be handled mathematically, the full significance of these effects can be shown. For our first example, assume that the lean absorption oil is Decane and that its vapor pressure at 80° F. is 10 mm., or 193 pounds. Abs. due solely to hexane. Further assume that the still temperature is 320°F. By Raoult's law the composition at 80°F can be computed, as well as the vapor pressure at 320°F.

Vapor pressure Hexane at 80°F = 3.05 pounds.
Vapor pressure Decane at 80°F = 0 pounds, practically.

By Raoult's Law
$.193 = N_1 \times 3.03.$
$N_1 = .0633$
or 6.33 per cent. mols
or 4.39 per cent. Saturation by volume.
Vapor pressure Hexane at 320°F = 145 pounds Abs.
Vapor pressure Decane at 320°F = 9.6 pounds Abs.

The vapor pressure of the mixture at the still temperature is then

$.0633 \times 145 + .9367 \times 9.6 = 18.2$ pounds as the total vapor pressure of the mixture.

Assuming that instead of this condition, the vapor pressure is that due to Butane and Decane and that

the pressure of 18.2 pounds absolute is the pressure that the still is set to give at the bottom, irrespective of feed.

The still operating under a definite temperature, pressure, and volume of agitation steam will always produce a given constant vapor pressure of lean oil, measured at the still outlet temperature, regardless of the composition of the oil entering.

The composition of the oil will then be given by formula:

$18.2 = 480\ N_1 + (1 - N_1)\ 9.6$

$N_1 = .0183$ or 1.83 per cent. Mol

or .962 per cent. volume enrichment.

In the above,

Vapor pressure of Butane at 320°F.=480 pounds Abs. (Extropolated)

Vapor pressure of Decane at 320°F = 9.6 pounds Abs.

N_1 = Mol ratio of Butane.

From this value of 1.83 per cent mol ratio of Butane we can compute the vapor pressure of the mixture at 80°F.

Vapor pressure Butane at 80°F = 36.6 pounds. Abs.

Vapor pressure of oil at 80°FF=.0183×36.6=.67 pounds Abs.

These values are shown plotted in curve No. 1. This shows that although the enrichment of the oil may be 4.39 per cent. by volume of Hexane, the vapor pressure at 80°F would be about one-fourth that of the oil having .962 per cent. by volume of Butane alone. This shows clearly why a saturation test alone on the lean oil will not explain results sometimes obtained in practice.

The question now naturally arises, how can a still be made to completely remove the lighter constituents and not put some of the oil overhead? This is being done by proper fractionation of the vapors leaving the stripper section. It can be clearly seen from the above that as the vapor pressure of the oil at the bottom of the still must be a constant for any operating condition where heat is applied in the still that if the heavier constituents are knocked back by the fractionating section, the lighter constituents must completely pass overhead.

This condition has been found to exist in practice. An operator using a still equipped as described by Mr. Ragatz, was surprised to find that the lean oil saturation was over 10 per cent. but the vapor pressure only about six millimeters at 80°F. He thought that conditions would be improved by lowering his saturation. The volume of reflux to the still was reduced and the lean oil saturation cut to about four per cent. but the vapor pressure had increased to about 16 millimeters. On increasing the amount of reflux again, the vapor pressure of the oil returned to its former value.

By the same line of reasoning as used above, it can be shown that a light absorption oil will give a lower vapor pressure lean oil to the absorber than a heavier oil. Curve No. 2 shows the condition that exists where the oil is assumed as dodecane using the same substances, butane and hexane, as before. In these calculations it is assumed that the vapor pressure of the lean oil at the still temperature was the same as before, or 18.2 pounds Abs.

Vapor pressure Hexane at 320°F = 145 pounds

Vapor pressure Dodecane at 320°F = 3.1 pounds

$18.2 = N_1 \times 145 + (1 - N_1)3.1$

$N_1 = .1065$ Mol ratio Hexane

6.54 per cent. enrichment by volume.

Vapor pressure at 80°F = $.1065 \times 3.05 = .325$ pounds Abs.

Vapor pressure Butane at 320°F=480 pounds Abs. (extropolated)

$18.2 = N_1 \times 480 + (1 - N_1)3.1$

$N_1 = .0317$ Mol ratio Butane

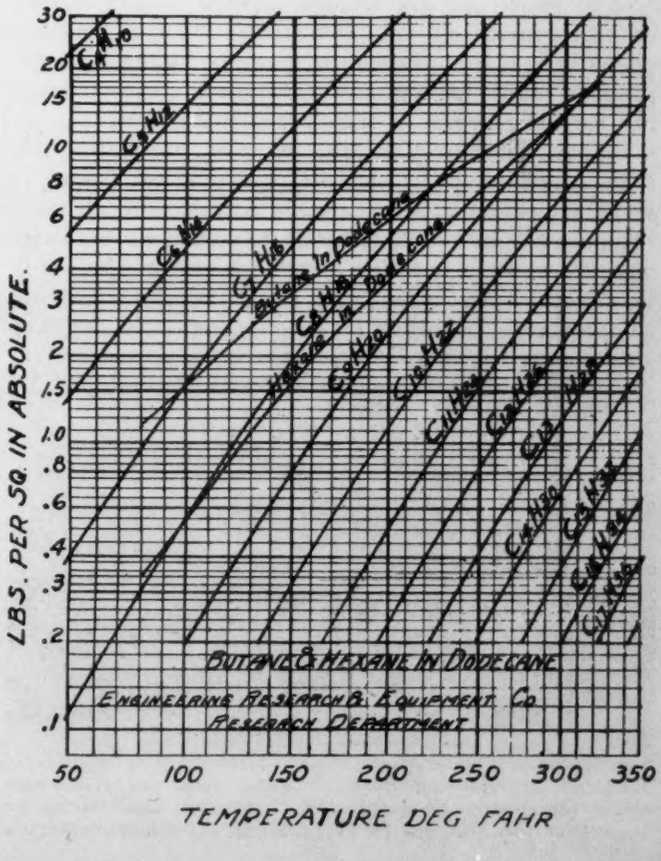
1.44 per cent. Enrichment by volume

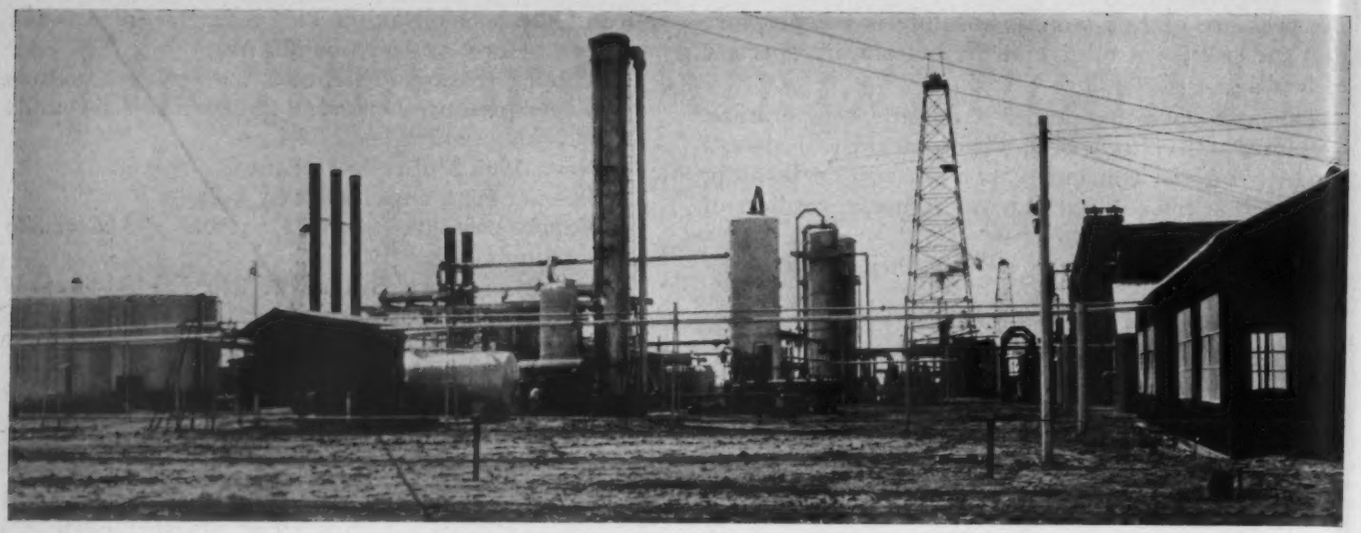
Vapor pressure at 80°F = $.0317 \times 36.6 = 1.16$ pounds Abs.

As another comparison of the advantage of light oil over a heavier oil on a vapor pressure basis, assume that the two oils, decane and bodecane, had dissolved in them as in the first example 4.39 per cent. by volume of hexane or .962 per cent. by volume of butane. The vapor pressures at 80°F of the two oils then on the same saturation basis would be for hexane in decane .1935 pounds and in bodecane .223 pounds; but for butane in decane .67 pounds and in dodecane .777 pounds.

These figures and curves show clearly that without a proper still in a plant, the full advantage of the absorbers cannot be realized.

Summing up, it is very apparent that the lighter absorption oils have a definite advantage over the heavier oils. A still capable of handling oil best adopted to absorption plant service is very important. With a proper still and with that still properly operated, the rest of the plant can be made to operate to its maximum efficiency.





Signal Gasoline Company's gasoline plant in the Big Lake field, Reagan County, Texas.

West Texas a Testing Ground For Natural Gasoline

THE deepest oil well in the world is located a few hundred yards west of the natural gasoline plant operated at Texon, Texas, by the Signal Gasoline Company. Before completion of this well at 8526 feet by the Texon Oil & Land Company, Signal Gasoline Company was processing natural gas from a shallower zone. This gas is contaminated with hydrogen sulphide to the extent of 8 to 12 per cent. The same condition prevailed at the nearby plant of the Big Lake Oil Company. University 1, yielding around 20,000,000 cubic feet of sweet gas, and producing 1800 to 2000 barrels of 57.4 gravity oil, has been helpful to both gasoline plants in that this gas may be used as fuel in the compression plants without any preliminary chemical treating for the removal of the hydrogen sulphide.

Signal Gasoline Company is now processing this sweet gas through its gasoline plant without having to wage a protracted battle against corrosion to all plant equipment. In addition to 20,000,000 feet of sweet gas, the plant is handling about one and one-half million feet of sour gas. The Big Lake plant was not so extensively benefited by the completion of the deep well, but it was enabled to secure sweet gas for the operation of its compression plant, and to eliminate the treating plant which formerly was employed to remove hydrogen sulphide from the fuel gas. In the near future it is expected that Big Lake Oil Company will have completed drilling deep wells now under way, and its gasoline plant will have sufficient sweet gas for maximum operation, getting away from the present corrosion difficulties incurred in the processing of the shallow sand production.

Scene of experimental work on Yates field gas production where the owners of a patented process are endeavoring to render the sour gas fit for gasoline extraction plants

At both plants in this field the hydrogen sulphide-removal plants have been shut down. Sufficient sweet gas is available to supply the two compression plants, the gas engines employed on the pumping wells, and the two large company camps.

SOUR GAS RICH

The sour gas in this region processed in the Big Lake plant is comparatively rich in gasoline, yielding between four and five gallons per thousand cubic feet. The condition of high sulphur content has been the retarding influence which has tended to prevent the installation of additional gasoline extraction equipment in the West Texas fields. It is improbable that the advent of sweet gas in this particular field, which is the oldest in West Texas, will result in additional installations of gasoline plants at that point, as the two plants now in operation may be easily enlarged to care for additional gas production as the deep producing zone is exploited.

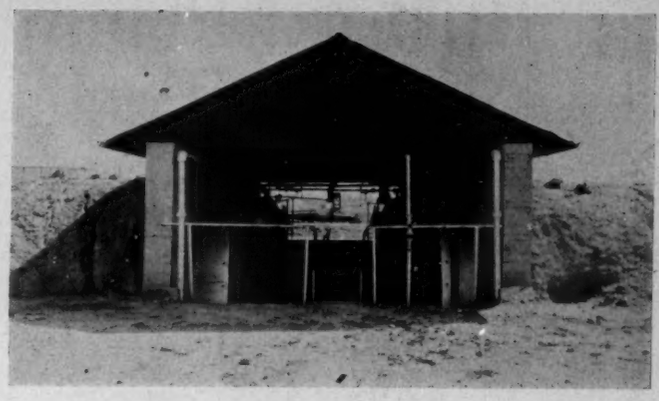
The experience of the Phillips Petroleum Company in the McElroy field of Crane County, where its gasoline extraction plant is handling sour gas through specially plated equipment and through devices of special design, may influence the future installation of gasoline plants in that area. Phillips Petroleum Company's absorption plant is located on a 60-acre tract in Section 216, just west of the mid-section of the Church-Fields-McElroy field. Assembly of material for plant con-

struction was begun early in August, 1928, and first production of natural gasoline occurred during the last week of January, 1929. The plant is the largest installation in West Texas, and most of its gas is obtained for 25 per cent. royalty. As the plant is located about 25 miles from McCamey, the nearest railway point, a long haul was necessary for moving in all plant equipment. The company avoided building a pipe line for transportation of gasoline to the railroad by making a long time contract with Humble Oil & Refining Company, to whom the gasoline is sold. Gasoline is taken into Humble Pipe Line Company's crude line and mixed with crude. Phillips Petroleum Company has practically all of the field's gas production under contract and is assured a supply for the plant for a long period, as the Gulf Production Company has barely scratched the surface on its McElroy leasehold with wells, and has several hundred proven locations that can be drilled as conditions justfy. In April there were 187 producing wells in the Church & Fields area, and 72 on the Gulf-McElroy section of the field.

In the Yates field, M. J. Leahy and Chestnut & Smith Corporation are experimenting with a patented process for cleaning the field gas production so that it may be processed through absorption installations.

With the volume of natural gas supplied by the world's deepest well, in the Big Lake field, the Signal Gasoline Company enlarged its gasoline plant through the installation of an additional Campbell absorber and added to its exchanger and preheater equipment. These additions increased plant gas capacity rating from 14 million to 21 million cubic feet. The gasoline content of the sweet gas production is slightly better than one gallon per thousand cubic feet.

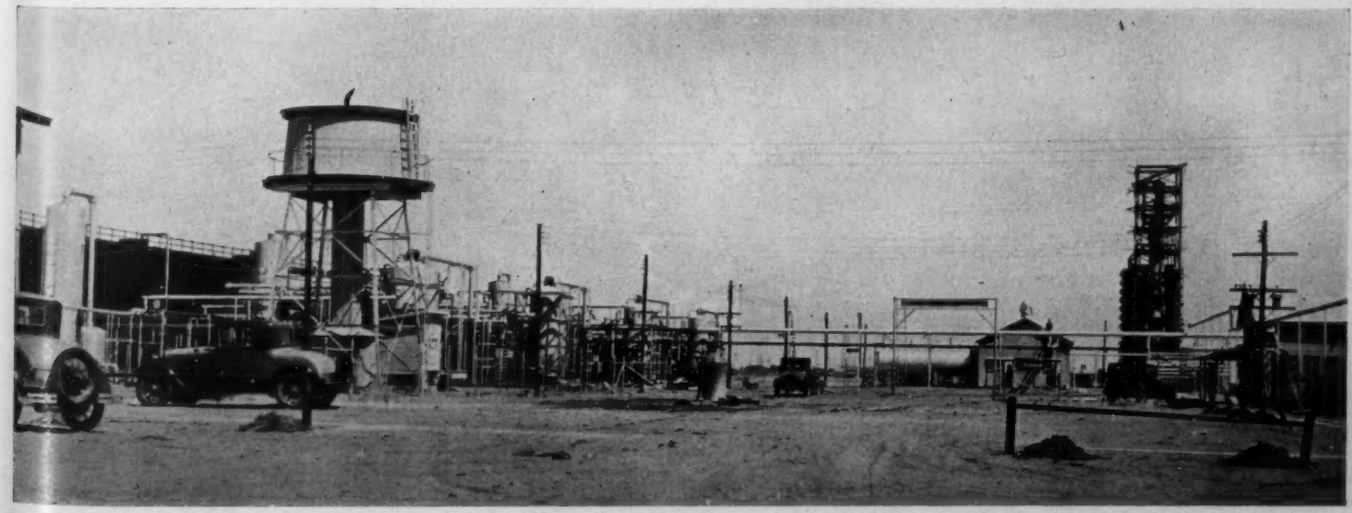
Both the sour gasoline from the natural gas of high hydrogen sulphide content, and the gasoline from the sweet gas produced in the Big Lake field can be treated to meet standard specifications by the hychlorite method. The greatest difficulty in chemical treating of the sour gas gasoline production is that of combating corrosion of treating columns. Both plants in the Big Lake field employ continuous treating systems. That of the Big Lake Oil Company was discussed in detail in THE REFINER AND NATURAL GASOLINE MANUFACTURER, issue of August, 1928. At the Signal Gasoline Company plant, six treating columns are used. The first three drums are employed for a preliminary caustic wash, which is followed in the last three treating columns by contacting and washing with sodium hypochlorite solution.



Six 24,000-gallon natural gasoline storage tanks at Signal Gasoline Company's plant, buried in an excavation and using earth as insulating material

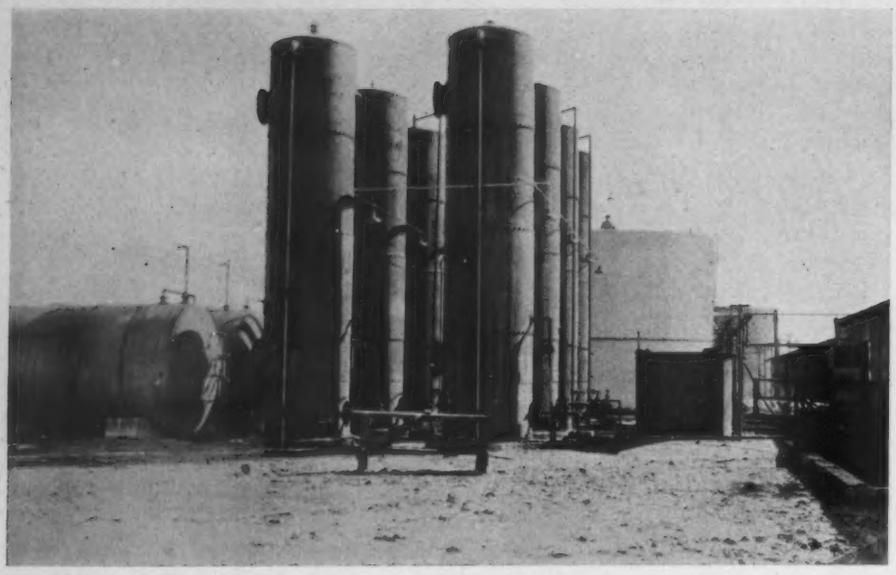
TABLE 1.
WEST TEXAS NATURAL GASOLINE PLANTS

Company—Field—Type	Gas Capacity Cubic Feet	Production Gallons	Status
MITCHELL COUNTY			
Atlantic Oil Producing Company, Westbrook, Comp.	230,000	160	temporary shut down
The California Company, Westbrook, Abs.	1,000,000	2,800	shut down
Magnolia Petroleum Company, Iatan, Comp.	100,000	300	shut down
HOWARD COUNTY			
Magnolia Petroleum Company, Chalk, Abs.	2,000,000	1,200	
REAGAN COUNTY			
Big Lake Oil Company, Big Lake, Abs.	10,000,000	16,500	
Signal Gasoline Company, Gig Lake, Abs.	21,500,000	23,000	
CRANE COUNTY			
Phillips Petroleum Company, McElroy, Abs.	50,000,000	35,000	



Phillips Petroleum Company's 50,000,000 cubic foot natural gasoline plant in Crane County, McElroy area, processing sour gas in specially designed equipment.

Burford Plant Adapted to West Texas Crudes



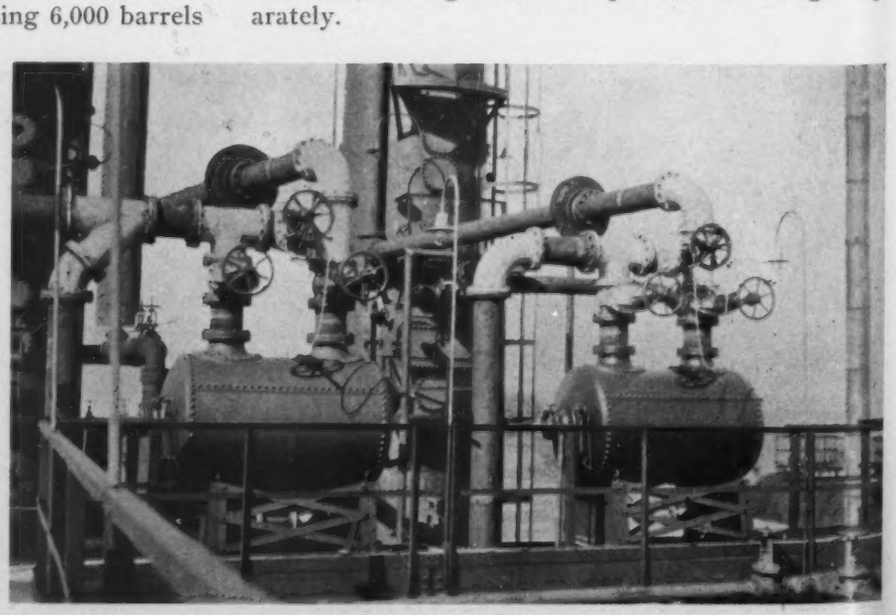
Continuous treating plants handling two grades of gasoline from Winkler County crude and treating to all standard specifications including sulphur content.

THE plant site of the Burford Oil Company at Pecos, Texas, accommodates the two-story brick general headquarters office of the company, and a number of roomy bungalows for employes, as well as the tank farm and modern tube still type of skimming plant, with two Jenkins cracking units in conjunction. The company is headed by F. W. Burford. Refinery operations are under the management of Mr. Burford and J. J. Thomas, vice president of the company. This plant is one of the first of the larger permanent refining installations to start manufacturing in the West Texas area. It was designed and constructed to operate on the sour crudes of the district, and is processing 6,000 barrels daily from the Hendrick field, Winkler County. Crude and vapor flow systems and other methods of operating offer some interesting features for discussion.

Cold crude is charged to exchangers with a unit of Byron-Jackson centrifugal pump and General Electric motor driven through a six-inch line. At the exchangers, of which there are 10, the cold stream of oil is divided into two circuits. One circuit passes through five of the Heat Transfer Products exchangers, where it is preheated by the hot gas oil leaving the reboiler section of the final fractionating column. The second stream of crude passes through a unit of five more exchangers in series, where it is heated by means of the out-going hot residuum from the evaporator section of the column. The 10 exchanger units are so manifolded that any one of them may be temporarily removed from the circuit for cleaning or repairs without causing the shut down of any other unit. After preheating in this manner, the two hot streams of crude are reunited and conducted to the first tower, which is a combination flashing-fractionating column and evaporator-separator. The exchanger pass raises temperature of the oil from atmospheric to 350°F.

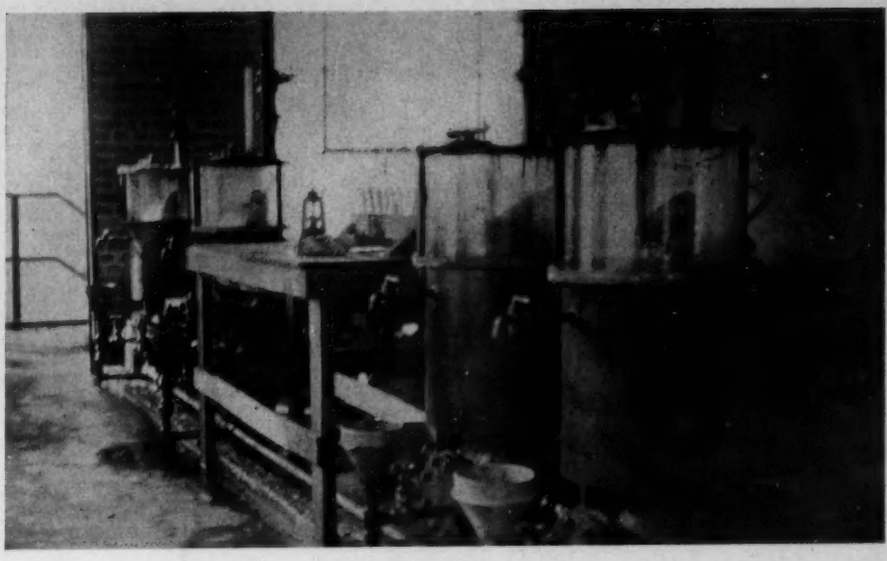
PREHEATING AND FLASHING

The preheated crude enters the first tower just above the third bubble tray, the vapors rising upward counter-current to descending recycle media, and the partially stripped crude falling to the lower compartment of the tower. At the point of entry the oil is stripped effectively by flashing with a jet of live steam as an aid in vaporization. Twelve per cent. of the total crude charge is removed in this manner, prior to subjecting the oil to retorting in the tube still. Dimensions of the tower are six feet by 56 feet. Gasoline refluxed over the top of this first tower is the same product that is derived from its operation, and is sprayed into the tower under regulation by a Leeds-Northrup automatic recording temperature controller. Gasoline over head from the first column is taken to condenser coils through an ammonia scrubber, through water traps and to storage separately.



Details of installation of alkali washing scrubbers neutralizing acidic steams of gasoline vapors distilled from Winkler County crude.

Residue from this preheating and flashing operation is picked up by the second centrifugal pump under rate control and discharged directly to the tube still. The tube still, as was the entire refinery, was built to company specifications by the Graver Corporation. In this still there is a total of 184 tubes of four-inch diameter. It was designed to process 6000 barrels daily. The oil flows into the preheater bank of tubes, then through the roof bank, out and down to the bottom of the convection bank, upward through this and out into the lower section of No. 2 tower. There are 64 tubes, 26 feet in length, in the roof bank, and 120 tubes, 30 feet in length, in the other banks.



Interior of receiving house showing details of installation of new type look-box designed by company engineers.

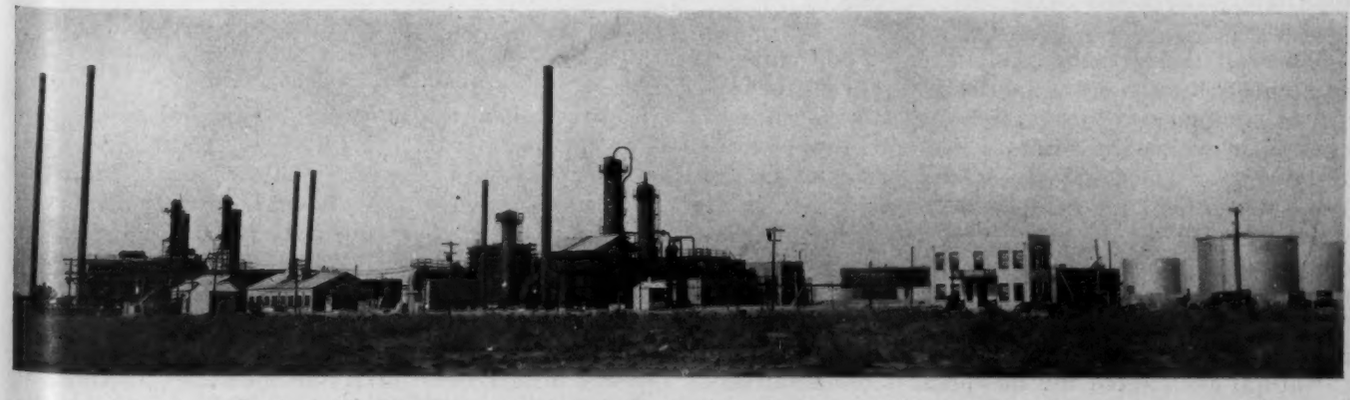
The retort is equipped with a Leintz recirculating system, and operates at oil temperature of 600 to 660°F. with a furnace heated to 1200°F. With 30 per cent. excess air the stack temperature averages around 500°F. Operating temperature of the retort is governed by the grade of gas oil or fuel oil required.

VAPORIZING

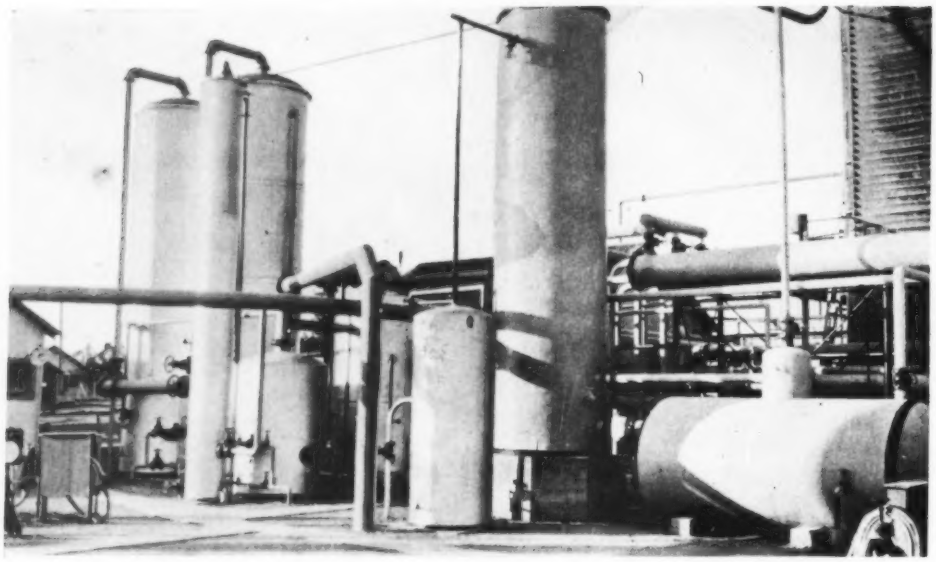
Crude and vapors enter the vaporizing section of the second tower, where the residum is collected and permitted to flow through control by a Fisher liquid level regulator through a Northern rotary pump. It is cooled through the exchangers and in water cooled coils before storing. Fuel oil gravity averages 18/19° A. P. I., with a zero-10 cold test. Naphtha and gas oil vapors pass from the evaporator flashing section into the upper bubble type fractionating section of the tower. Cold naphtha is recycled over the trays in this tower to regulated temperature and aid in rectification. Dimensions of this tower are seven by 72 feet. An accumulator section is provided at the bottom of the upper or fractionating portion of the column, from which the gas oil is removed as a side stream. This hot gas oil, as previously mentioned, is employed in a series of five exchangers as a means of preheating the incoming cool crude. The overhead stream of naphtha vapors is passed into an individual ammonia scrubber and condensed separately.

Vapors pass into the ammonia scrubbers flowing downward to the bottom of the drum and are caused to flow upward in a whirling motion by means of a baffle device, and out through a second vapor line at the top of the drum. The scrubbers are three by five feet in dimension. Weak ammonia solution is sprayed into the drum against the whirling vapors, for neutralization of the wet and acidic hydrogen sulphide gas. Three block valves are provided so that the alkali-scrubbers may be by-passed temporarily in the event of needed repairs, etc. The higher valve is equipped with a chain driven valve wheel, making it easily accessible to the operators. This is in line with the general practice of providing all available types of safety guards, railings, and stairways about the plant. Ladders extending upward along the side of the fractionating columns are surrounded by a heavy steel guard encircling the employee when it is necessary to climb to the top of the columns. All valves located above reach of the workman, are provided with chain driven valve wheels where possible. Ladders are avoided when other devices can supplant them. Above the condensers safety walkways are in-

(*Continued on page* 92)



Burford Oil Company's 6,000 *barrel plant and headquarters office at Pecos, Texas.*



Absorption and distillation equipment at Gilmore-Dabney No. 2 plant, Long Beach. The small secondary absorber is shown in the left foreground. The "washer-scrubber" is shown at the second tank to the right of this absorber.

Effective Gas Cleaning Methods Used By Gilmore-Dabney Oil Company

THE three natural gasoline plants of the Gilmore Oil Company and Gilmore Dabney Company in the Long Beach, California, field, all of which treat gas mostly from the deeper producing zones in this field, were designed to incorporate latest modern practices in natural gasoline extraction.

Centralization of control through the installation of recording and indicating devices as nearly as possible in one room, lends to the ease of operating the plants. Special small houses are provided in which all meters recording gas in and out of the plant are set. This practice virtually eliminates the troubles traceable to vibration occurring where meters are carelessly placed about the plant yard, and stops exposure of this costly equipment to the elements. Charts are more quickly and easily changed and inspection of the instruments is made easier through accessability. Instruments for control and regulation of operation of the plants have been provided to the point that operators actually have little to do other than read gauges and place their records on the report sheets.

Since all three of the plants consist of Campbell equipment throughout and differ little except for layout of equipment which varies due to difference in sites upon which the plants were built, the Gilmore Dabney No. 2, located on Atlantic Avenue in the Long Beach field will be discussed at this time. Sites were prepared for the plants through the use of decomposed granite which has the advantage over most plant yard materials of settling evenly with use and becoming harder and firmer and not washing when exposed to rains.

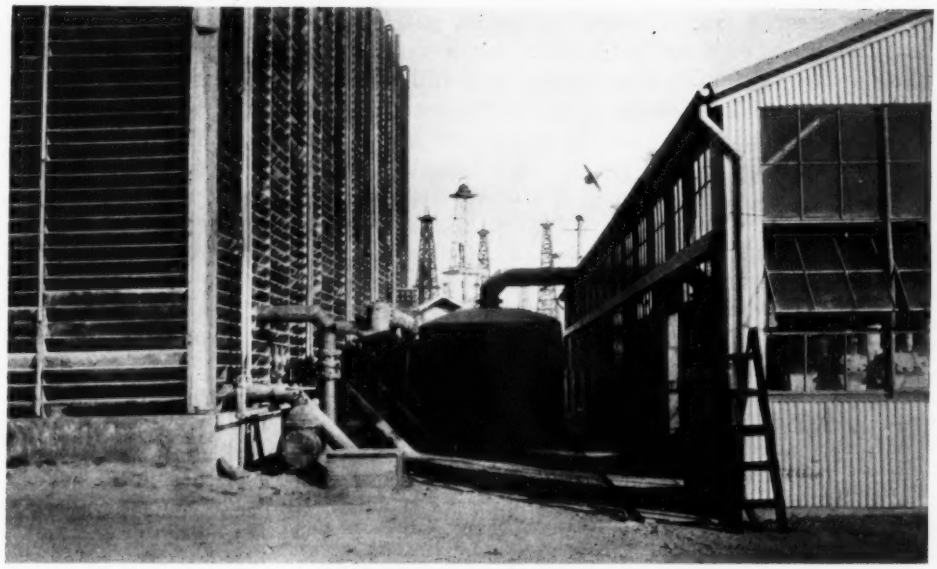
Natural gas treated and this plant is comparatively rich and when subjected to compression to plant operating pressure the subsequent cooling causes the condensation of an appreciable quantity of compression gasoline. Boosting to 35 pounds pressure is done through six Clark machines of 180 horse power, size 18 by 20 inches. After compression and cooling the gas is conducted through an Oil Froth type of washer-scrubber.

One of the problems in natural gasoline plant operation is that of effecting complete removal of foreign matter which comes in with the gas, especially in flush producing areas. This foreign matter consists of crude oil mist, water, and finely divided solids such as calcium carbonate silicia, and rotary mud. Much of the solids are removed in the primary scrubbing before compression, but a small proportion will pass through the compressor plant along with the water and some oil. These substances tend to form emulsions with absorption oil which are difficult to break down and which greatly impair the efficiency of the absorbing medium, and if unchecked will eventually reduce the efficiency of all of the absorption plant equipment in the oil circuit.

SCRUBBING SYSTEM

The washer-scrubber is a cylindrical tank eight feet in diameter by 12 feet high, containing three perforated froth plates provided with means for flushing each plate with water to wash down the emulsion or accumulation of foreign matter, through individual drains to the bottom of the scrubber and away through sewer lines. Near the bottom of the scrubber is set a small steam pump which takes suction on the condensate accumulating in the scrubber and pumps it back over the top of the series of plates, at the rate of about five gallons per minute. This tends

to facilitate removal of the condensed gasoline carried into the scrubber from the cooling coils. Any excess condensate containing the crude or any other foreign matter which is not drained off with the occasional water wash, is removed from the scrubber through an automatic liquid level control device and taken to a small settling tank. Gasoline from this tank is removed to a small stripper still and rerun to recover the compression gasoline. In addition to effecting the removal of foreign matter from the incoming gas to the absorbers, this practice, which is becoming popular in California and other districts, has the additional advantage of the removal of all compression gasoline from the gas, which reduced the load on the absorbers and the work to be done by the absorption medium, as well as reducing the load on the major distillation apparatus, all of which tends toward increased capacity for the given installation. Absorption oil retains its efficiency over longer periods.



A separate cooling coil for each compressor is used. Gases cooled in all coils converge into a common header. In the event of leaks or needed repairs, but one machine is taken from service where this practice is followed.

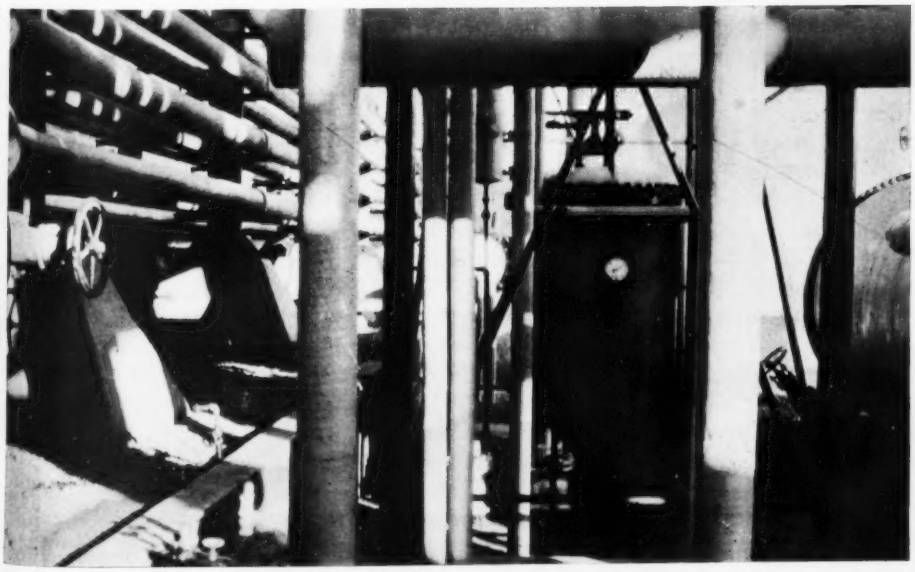
Gas from the washer-scrubber passes through two Campbell absorbers and into the residue line. Rich oil passes through the tubular type heat exchangers and into the three elevated horizontal preheaters. These preheaters are heated with live steam and due to their elevation sufficient head is secured to effect the draining of all condensed water back to the boilers. Each preheater is also provided with a small vent line which eliminates the occurrance of gas or air pockets in this equipment which would tend to reduce their efficiency. The recovery of condensed water in this manner prolongs the service periods of the boiler equipment.

After preheating and distillation, gasoline vapors are condensed in the usual manner. At a point close to the top of the still the small vapor line from the stripper still, previously mentioned, enters the main vapor line so that all gasoline vapors are condensed in the same coils, and accumulated in one stream. The gasoline leaving the condensers is conducted to the low-pressure stabilizer unit, which is steam heated, carefully controlled, and the wilder ends removed.

SECONDARY STILL

All of the light vapors from the stabilizer of low pressure fractionator, and gases from storage tanks, are then passed into a small secondary or "tail gas absorber," and re-treated. A stream of lean absorption oil is taken from the main oil circulating line and passed through the secondary tail gas absorber, to pass back into the enriched or fat oil lines just before it enters the distillation equipment. In this manner the tail gas absorption equipment is operating independent of the main plant, but working along with it. Residue gas from the secondary absorber is conducted from the plant through the residue lines.

After passing through the absorption plant all gas is taken through a final scrubber where any mechanically entrained oil is removed. This oil is taken to the stripper still and distilled and cleaned up for further



The small stripper still through which all compression gasoline and scrubber accumulations are redistilled is located near the base of the main still. It is automatically controlled and in continuous operation. Vapors unite with the main plant still vapors in the vapor line just above.

use in the oil circuit. The stripper still or secondary still is another item of plant equipment which is rapidly becoming extensively employed in the natural gasoline industry. At this plant the stripper still is charged from a small tank as previously mentioned and distillation carried out by means of live steam. Its primary advantage lies in the fact that through its use the main plant product is kept free of contamination, and any re-distillation which may be necessary can be performed without working through the primary distillation apparatus. It is a complete small system within the large system working simultaneously with the main plant but independent of it.

In this installation the stripper still is located near the main still and its small vapor line enters the major vapor line just above. Some of its uses have already been mentioned. In addition, if a small batch of gasoline is off color or other specification for any reason, it is an easy matter to re-distill it in the stripper still without interfering with main plant operation in any way.

Run tanks at the Gilmore Dabney plants are all small, as is becoming customary with all of the new installations, for the reason that should some accident occur which would throw the plant product off color or off specification, there is much less of the finished product to re-run. Two small run tanks are provided and used alternately. Gasoline is stored in larger tanks located nearby only when it meets all required specifications.

Another item which has been given attention at this plant is the location of manually operated valves. Where possible, all valves are placed about waist-high to the operators. This does away with climbing ladders to a large extent and also lets the operator maintain a vertical position so that he can not be caught in a crouch in the event of fires, etc. It is not necessary to place valves on top of a tank simply because a line is placed at the tank top.

The four boilers comprising the power plant are located at a lower level than the plant, taking advantage of a hill side, upon which the plant is located. The boilers are automatically controlled and no additional labor is necessary for their operation. Boiler blow off lines extend to an expansion or blow-down drum located near the water cooling tower pit. Each boiler is blown down through the expander through a separate line, and no steam can flow back to an empty boiler to endanger the lives of workmen cleaning out. The water is collected in the blow down tank or expander and drains to the water pit and saved for re-use.

Burford Plant Adapted to West Texas Crudes

(*Continued from page* 89)

stalled, and electric lights are placed every 10 feet. At such points where it may become necessary for a man to work at night, lights are provided.

SAMPLING

Gasoline, after condensation, flows into the receiving house through look-boxes, especially designed by company engineers, which are gas tight, and at the same time render the streams highly visible. By providing means for the gasoline to enter the boxes from the bottom through a four-inch riser encased in a gas tight vessel, it is possible to insert the sampling line directly into a solid stream of upward flowing distillate. Samples are drawn off the streams through small one-half inch lines and under the faucets used at each look-box there is a series of funnels which catch all drippings and spills and conduct this material away through a common line to the sewer and traps. Details of this new type of look-box are shown in the accompanying photograph of the receiving house. Gas lines are installed to carry away all odors and uncondensed vapors. Such safety measures are esesntial in the operation on West Texas crudes high in hydrogen sulphide content.

Both streams of gasoline are handled separately through the refining equipment, storage and treating plants, and are blended in proportions required to produce various grades of finished motor fuel. Present operations secure a yield of 27 per cent. of 400 End Point gasoline, with a benzol equivalent valve reported at 42 per cent. No kerosene is produced and the second cut of gas oil averages 34 per cent. at 28 gravity. Some idea of the efficiency of the fractionating equipment is indicated by the negative gap secured between these two products. The gas oil fraction has an initial boiling point of 410 as against an end of 400 for the motor fuel.

WATER SOFTENING

Well water is employed for cooling and boiler plant use, and this water averages 180 to 240 grains hardness. Vegetable compounds are being employed to soften the water for boiler use. Temporary hardness is removed by preheating. The operators employ a home-made feeder for handling the vegetable compound as it is injected into the water stream. A three-foot length of eight-inch pipe was welded at each end to make the container. A gauge glass is provided to show the firemen at what rate they are feeding the compound, and by means of which they can control the feeding. The softening compound is poured into the tank, and its outward flow is controlled by the manual operation of one-inch valves on the outlet lines. As the pump operates it pulls on the supply of compound taking it to the pump with the water, where the two are intimately mixed, and the reaction is completed in the boiler. The rate of feed of compound is determined by laboratory control methods and checked periodically.

A steam-level blow-off system is installed and a continuous stream of water is removed at this point, since this is the point of greatest concentration of the sludge. The boiler is also cleaned of precipitated solids by blowing off at the bottom every two hours. This system of operation allows the boilers to remain in operation one week, whereas much shorter periods of operation would be practical without it.

Cup Grease Manufacturing Methods

By H. L. KAUFFMAN

THIS is not offered as an argument that the refiner, not now making cup grease, should engage in the manufacture of that product; for, whether or not this is advisable depends on many influencing factors.

The subject will be offered in two parts. This part deals with formulae and detailed methods of operation, as they have come under the author's personal observation and experience.

The second part will appear in a forthcoming issue.

THE larger number of the greases on the market today may be classified as cup greases. Most of the cup grease made is used in lubricating parts of the automobiles, trucks and tractors that are now in use.

Nearly all cup greases are calcium-soap greases and are made by saponifying a fatty oil with slaked lime. A few greases that are sold under the name of cup greases are soda-soap greases. There are also some so-called cup greases than contain combinations of soda and lime soaps; while a few years ago there was brought to the writer's attention a grease containing aluminum soap, which was being sold as a cup grease.

Cup grease is probably the best known and most common example of the hot-set, or boiled, type of grease. Cup grease is mainly an emulsion of calcium soap and mineral oil. The grease, however, contains also a small percentage of water, which aids in preventing the separation of the oil from the soap. All of the greases of this type have a smooth, homogeneous feeling when the finger is passed through the product, and have a characteristic appearance which, if once recognized, will not be forgotten very readily.

All lime-soap greases are insoluble in water and leave a white, insoluble residue of lime upon "ashing" a sample of the grease. Cup greases should be bright, transparent or nearly so, and be free from soap lumps, oil pockets, or separations of any kind; in addition, they should be perfectly uniform and neutral. Cup greases are made to consistency, the grades usually ranging from No. 00 to a No. 6. The soap content of this type of lubricant as a general rule varies between 10 and 26 per cent.

FATS AND FATTY OILS

Without doubt, cup greases are the most difficult to manufacture. To make consistently a uniform product of good quality requires the greatest possible care.

The appearance and physical characteristics of the finished grease depend to a large extent upon the kind of fatty oil used in making the soap. There are a number of vegetable and animal oils used in the manufacture of cup greases. Each oil forms a lime soap of fairly well-defined characteristics. Horse oil, beef tallow, mutton tallow, lard oil and acidless tallow are the animal oils that are most frequently used; while cottonseed oil, soya-bean oil, corn oil, palm oil, cocoanut oil and peanut oil are the vegetable oils that quite often are utilized. It must be remembered, of course, that mixtures of any or all of these can be used with success—the combinations that are used depending upon the particular characteristics desired in the finished grease.

Horse oil is probably the most frequently used fatty oil for making cup greases. The calcium soap of horse oil will give the grease a high melting point and a smoothness difficult to obtain with other fats; however, it also gives a disagreeable odor, which is usually disguised by the use of oil of myrbane (nitro-benzene) in the grease. Palm oil forms a soap that will give the grease a high melting-point and a satisfactory color and odor, but the finished product will lack the smoothness that is obtained more readily by the use of horse oil. The lime soap of soya-bean oil in a grease gives a soft product of low melting-point. Because of its odor, cocoanut oil is seldom employed in the manufacture of cup grease, since it can not be used without the source of the oil being evident.

Much of the success of grease-making depends upon the kind and quality of the fatty oil used; consequently, most manufacturers buy these products upon their own specifications, and then check the quality of the product by making both physical and chemical laboratory tests before accepting the shipment.

No. 1 lard oil used by one grease manufacturer is bought on the specification that the oil must be pure lard oil, unadulterated, of the lightest possible color, and containing not over 15 per cent. of free fatty acids. Typical tests on this product are as follows (Table 1):

TABLE 1
TYPICAL TESTS ON LARD OIL

Gravity °Be	22.6
Flash °F.	420
Fire °F.	490
Viscosity at 100°F., seconds	205
Color, Lovibond, ½-inch cell	120
Pour test °F.	40

Saponification value 197
Iodine value 75
Free fatty acids, per cent. 15.0

This same manufacturer uses nearly all cottonseed oil in making cup greases. Either the prime summer yellow or prime summer white grade is bought. Typical tests on these products are shown in Table 2. It will be noted that the principal difference between the two is in their color.

TABLE 2
TYPICAL TESTS ON COTTONSEED OIL

	Cottonseed Oil Prime Yellow Summer	Prime White Summer
Gravity °Be.	22.3	22.3
Flash °F. 605		605
Fire °F. 675		675
Viscosity at 100°F., seconds 180		180
Color, Lovibond, 6-inch cell 100		20
Cold test °F. 35		40
Saponification value 195		195
Iodine value 110		110
Free fatty acids, per cent. .....none		none

Another manufacturer, who uses horse oil almost exclusively in making cup greases, buys it on the following specifications (Table 3):

TABLE 3

Moisture	none
Impurities, per cent., maximum	0.5
Saponification value 190-210	
Free fatty acids, per cent., maximum....	20.0
Flash °F., minimum	400
Cold test °F., maximum	70
Color, N.P.A., maximum	6

Typical tests on horse oil as purchased by this grease-maker are shown in Table 4.

TABLE 4
TYPICAL TESTS ON HORSE OIL

	Horse Oil Sample No. 1	Sample No. 2
Gravity °Be.	23.8	23.0
Flash °F. 415		470
Fire °F. 470		535
Cold test °F. 60		50
Viscosity at 100°F., seconds.....238		234
Viscosity at 210°F., seconds 55		..
Color N.P.A. 6		5
Color, Lovibond, ¼-inch cell 70		..
Saponification value 195		193
Free fatty acids, per cent. 20.0		8.4
Iodine value 60		..

This same manufacturer also uses cake tallow in making certain grades of cup grease, the tallow being purchased on the following specifications (Table 5):

TABLE 5

Moisture	none
Impurities	none
Flash °F., minimum	500
Color, N.P.A.	2
Saponification value 190-210	
Free fatty acids, per cent., maximum....	3.0

Typical tests on cake tallow of the grade that meets the above specifications are shown in Table 6.

TABLE 6
TYPICAL TESTS ON CAKE TALLOW

	Cake Tallow Sample No. 1	Sample No. 2
Gravity °Be.	24.5	24.0
Flash °F. 500		530
Viscosity at 210°F., seconds 57		58
Cold test °F. 86		96
Color, N.P.A. 2		2
Saponification value 199		197
Iodine value 46		46
Free fatty acids, per cent..... 3.0		2.1

EQUIPMENT REQUIRED

Cup greases are made in either one or two kettles, depending upon the nature of the product and the facilities of the manufacturer. The use of two kettles is generally considered to make the batch subject to closer control; furthermore, a more uniform consistency is usually possible where two kettles are used. However, many grease-makers use only one kettle.

Grease kettles vary in size from 10 to 50 barrels. The capacity of the kettle used will depend upon the size of the grease plant and the quantity of cup grease marketed.

Modern grease-kettles are either partly or entirely steam-jacketed. All have conical-shaped bottoms, so that the product can be drawn more readily from the kettle. As a rule, the top of the kettle is flush with the floor level, the bottom of the kettle extending through to the floor below where the grease is drawn.

All grease kettles are equipped for mechanical agitation. The stirring paddles are either belt-driven from a main shaft, or an individual motor is the source of power. Usually, the agitating device can be so geared as to obtain a variable speed of agitation. The type of stirrer or paddle used to agitate the contents of the kettle varies somewhat; but, for the most part, a stirring device consisting of from four to eight paddles, six inches in diameter, and fitting as closely as possible to the sides of the kettle, proves satisfactory. In some cases, the agitating device is such that an equal number of paddles are revolving in opposite directions. Such an arrangement insures the thorough mixing of the contents of the kettle.

Other equipment involved in the manufacture of cup grease are tanks for the storage of both the fatty and mineral oils; pumps, and steam, water and oil connecting lines; barrels or kettles for slaking and screening the lime, if quicklime is used; together with a can- or barrel-filling machine, if the containers are to be filled automatically.

PROCESS OF MANUFACTURE

As an aid in maintaining the uniformity of the product, it is an advantage to determine the saponification value of the fatty oil, as well as the percentage of available calcium oxide present in the lime. With this data, it is possible to calculate accurately the weight of lime required for the complete saponification of the fatty oil.

Most grease-makers slake their own lime rather than use chemically hydrated lime, which latter is

considered by some to be an advantage. The method followed in slaking the lime, therefore, is an important step in the manufacture of cup greases.

A very successful procedure followed by one grease-maker consists in slaking the lime in barrels, first adding enough water to the barrel to cover completely all of the lime that is to be added. The quicklime is then gradually added to the water, and upon the slightest appearance of escaping steam the contents of the barrel is quickly and thoroughly stirred, adding an additional quantity of water from a hose when it becomes necessary to stop the steaming. Sufficient water is added during the slaking process so that the temperature at no time exceeds 160° to 170°F. After complete slaking, the mixture is allowed to remain undisturbed four or five hours, during which the slaked lime falls out and leaves a layer of clear water above it. The clear water holding any soluble impurities is then carefully decanted off and thrown away. The lime paste that remains is screened before it becomes available for use in making cup greases.

Another manufacturer slakes the lime in a large tub placed adjacent to the grease kettle. Seventy pounds of lime are slaked at one time, using approximately 75 gallons of water for this quantity of lime. The lime is added to the water, which is first warmed with live steam to approximately 110°F. Upon the addition of the lime to the water, the reaction causes violent ebullition, and for this reason cold water is added to prevent boiling over, if the reaction becomes too violent. After each lot has been thoroughly slaked, the hydrated lime is run through a fine screen before entering the grease kettle.

Mechanical lime slakers are used by some grease-makers.

When a comparatively slow slaking lime has been purchased, it is sometimes necessary to use live steam in order to expedite the slaking process.

In all cases, the slaked lime is carefully screened before it passes into the grease kettle. Usually, it is first passed through a coarse screen, in order to remove the larger lumps, and then through a very fine copper screen. Too much care can not be taken in seeing that the lime is well slaked, and that it enters the grease kettle in as pure a form as is possible.

MAKING THE GREASE

An example of the manner in which cup grease is made is shown by the following detailed description of the procedure followed by one grease-maker. This manufacturer uses cottonseed oil in making nearly all cup greases but, since cottonseed oil alone is very difficult to saponify, small quantities of both No. 1 lard oil and cottonseed oil fatty acids are also added to the kettle.

The cottonseed oil, 100 gallons, is added to the kettle late in the afternoon of the day previous to the one on which the batch is to be made. To the kettle are also added at this time 10 gallons of No. 1 lard oil and five gallons of cottonseed oil fatty acids. The slaked lime, 140 pounds of calcium hydroxide (the equivalent of 106 pounds of quicklime), is then carefully screened into the kettle.

Theoretically, only about 9.7 per cent. by weight of lime to fatty oil is required for the saponification of a fixed oil. Practically, however, an excess of lime is required for the complete hydrolysis of the fatty oil in an open vessel, the percentage required varying from 12 to 14 per cent. The manufacturer whose process of operation is being described, as a general rule, uses 12 per cent by weight of lime to fatty oil.

Steam is turned into the jacket of the kettle, and the temperature of the contents allowed to reach approximately 130°F. The lard oil and cottonseed oil fatty acids react more quickly with the lime than does the cottonseed oil, so that emulsification takes place fairly readily, and the lime and cottonseed oil soon begin to react. Agitation is started and continued usually for two hours, with the steam off, after which the contents of the kettle are allowed to remain undisturbed until the following morning. By so doing, most of the reaction takes place during the night.

Sometimes 20 gallons of mineral oil is added to the kettle at the same time that the lime and fatty oil are added. In such a case, the soap is formed in the presence of this small amount of mineral oil.

In the morning steam is turned into the jacket of the kettle, agitation started, and the lime soap dried as much as possible. A small amount of water, must remain in the soap or a separation of oil will take place when the mineral oil is first added to the kettle. after a time the soap dries and appears as a crumbly mass which, in turn, becomes smooth upon further heating due to the melting of the lime soap.

When the last lumps of soap have disappeared the mineral oil, warmed so that no sudden nor extensive cooling of the batch takes place, is added very slowly to the grease kettle over a period covering several hours. The mineral oil used by this grease-maker shows the following physical tests (Table 7):

TABLE 7

PHYSICAL TESTS ON MINERAL OILS USED IN MAKING CUP GREASES

Gravity °A. P. I.	24.3
Flash °F.	320
Fire °F.	375
Viscosity at 100°F., seconds	140
Viscosity at 130°F., seconds	85
Viscosity at 210°F., seconds	40
Pour test °F.	30
Color, Lovibond, 6-inch cell	250

Extreme care is necessary during the addition of the mineral oil in order to avoid the formation of soap lumps. However. after approximately 20 per cent. of the oil has been added to the kettle, the remainder can be added at a much faster rate without danger of spoiling the batch.

In order to improve the appearance of the finished product, four ounces of oil-soluble yellow dye in solution in mineral oil is added to the kettle, usually at the start of the mineral oil into the soap.

This grease-maker uses two kettles in manufacturing cup greases. The one kettle is placed just above

the other. Uusally, the grease is brought to from 80 to 85 per cent. completion in the upper kettle and is then screened into the lower kettle where it is finished.

About 10 pounds of a 10-per cent. solution of caustic soda are added in the lower kettle, this alkali uniting with any uncombined fatty oil remaining in the grease to form a small quantity of soda soap. This soda soap seems to increase the permanency of the emulsion and does much to prevent any appreciable separation of the mineral oil from the lime soap.

The remainder of the mineral oil (usually a total of approximately 425 gallons is used in the manufacture of a No. 3 cup grease) is added to the grease in the lower kettle, and the batch "worked" for some time at temperatures ranging from 160° to 170°F.

Before adding all of the mineral oil, samples are taken from the batch to note the appearance and the consistency, the former depending largely upon the amount of water in the grease. If the grease at this point has a rubbery appearance, it indicates a low percentage of water and more should be added. A grease in this condition is sure to separate oil on standing. With most batches, additional water must be added at this stage. This is added slowly and carefully, for the addition of too much water will appear in the finished product as free water.

As regards the quantity of water present in the grease, the following points are worth noting:

1. If a relatively large amount of unsaphonified fatty oil is present in the finished lubricant, it indicates that the proportion of water used in making the grease was smaller than in a lubricant containing the same amount of soap, but little or no free fatty oil.

2. Lime soap prepared from one and the same fatty oil, under similar conditions, always "fixes" the same quantity of water.

3. The percentage of water in a solid lubricant increases with the percentage of soap.

4. Calcium soap greases, in which heavy mineral oils are incorporated, require more water than those containing the same quantity of soap, but prepared with a light-bodied mineral oil.

5. If the soap be prepared separately in the pure state, the incorporation of the mineral oil requires more water, the harder the soap.

6. Every neutral fat requires less or more water according to the ease or difficulty of its saponification with lime.

7. The quantity of water required also varies with the amount of solid fatty acids in the oil to be saponified.

The amount of water present in the different grades of cup grease will vary, with the grade of grease made, from one-tenth of one per cent to three per cent.; but, for a No. 3 grade, it will average approximately one per cent.

Cup greases are made to consistency. They do not all come to a given consistency with a given amount of soap, so the quantity of mineral oil added is not the same for every batch. It is while the grease is being finished in the lower kettle, i.e., while being worked to the desired consistency, that a laboratory determination of the consistency of the grease is possible and will do much to aid the grease-maker in ascertaining the final amount of mineral oil to be added.

It must be remembered, however, while working the grease at this point that, if the batch is stirred too long, a fall in consistency will take place. A No. 3 grease will fall to the consistency of a No. 1 on continued working at a low temperature. The consistency of the grease while in the kettle is not the same as its consistency several days later, but there is a definite relationship between the two, and a drawing consistency can be determined for each grade of grease.

Five pounds of oil of myrbane are added near the completion of the batch to give the grease a pleasing odor. Some grease-makers maintain that this also acts as a preservative for the grease and serves to prevent, or to reduce to a minimum, any tendency of the grease to drain oil on standing for a long period of time.

Near the end of the process, the grease is kept just soft enough so that it can be drawn easily from the kettle. The usual drawing temperature is about 150°F; sometimes 160°F; but never higher than 170°F. From an opening in the bottom of the kettle, the grease is then drawn off into the type and size of containers desired.

Table 8 shows the quantities of raw materials used by one manufacturer in making four different grades of cup grease.

TABLE 8

FORMULAS FOR MAKING VARIOUS GRADES OF CUP GREASE

	No. 00	No. 1	No. 3	No. 5
No. 1 Lard Oil, Gals.	10	10	10	10
Cottonseed oil fatty acids, Gals	5	5	5	5
Cottonseed oil, Gals.	100	100	100	100
Oil of myrbane, Lbs.	5	5	5	5
Oil-soluble yellow dye, Ozs.	4	4	4	4
Slaked lime, Lbs.	140	140	140	140
Water	This is indefinite.			
Mineral oil (pale oil having a viscosity of 140 seconds at 100°F.)	510	480	425	320

The mineral oil is added until the grease is of the desired consistency, so that the figures given in the preceding and subsequent tables for the number of gallons of mineral oil incorporated in the grease are merely approximate.

A second grease-maker uses the following formula in making a No. 3 cup grease:

Horse oil, gallons	225
Quicklime, pounds	225
25° paraffin oil, gallons (approximately)	1115

The tests on the mineral oil used are shown in Table 9:

TABLE 9

TESTS ON 25-DEGREE PARAFFIN OIL

Gravity °A. P. I.	27.5
Flash °F.	385
Fire °F.	440
Viscosity at 100°F., seconds	150
Color N. P. A.	4
Cold test °F.	32

(Continued on page 135)

Special Precautions for Handling Sulphur Crudes at Refineries

By D. G. COOPER*
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IN handling sulphur crudes, most notably those obtained from the West Texas fields, hazards to personal safety and severe corrosion of equipment are encountered. The inherent basis of these factors is the presence of hydrogen sulphide gas which occurs in solution in the fresh crudes or is evolved later through decomposition of sulphur compounds during some phase of processing.

Since the hazard exists in nearly all phases of the handling of these crudes, from the well through the various refining processes, the utmost care in procedure must be followed. Moreover, since it is a human vice, or virtue, to take chances, an educational plan and strong disciplinary measures are necessary in impressing operators of the safety aspects involved.

Since the scope of this hazard is so general it becomes a problem which must be handled in a systematic and scientific manner. The ideas of all departments, such as chemical, engineering and operation, must be co-ordinated in order that safety rules and regulations may be as complete as possible. It is not necessary to depend entirely upon private research nor individual ideas and this is not done. All articles issued in the various journals, as well as bulletins by the Bureau of Mines, etc., are studied with a view to supplementing data obtained in particular plant operations or research. For this reason, in preparing this paper, it has not been the writer's viewpoint to treat the subject personally, but rather to assimilate the work done by various department heads. Their work has been collected either from outside sources or from their own research and experiences.

In handling such a problem, the plant laboratory comes first in importance. Its duty is to make preliminary investigations of the crude oil to be handled, giving the chemical aspects of the case and securing sufficient data so that the operating units and the plant as a whole may be properly informed before the hazard is encountered. The next in importance is the safety department, which formulates all existing data into a set of rules and regulations, taking the necessary steps to properly inform the various departments as to the conditions involved, etc. Next in line come the operating departments which must follow out the procedure set and handle neutralization processes, next the engineering department, which makes the necessary inspections, reports upon safety conditions with reference to the strength of materials and equipment, etc.

The following resume gives the scope of the work as well as the safety measures and practical application in dealing with this hazard.

*Before the Petroleum Section at the Seventh Annual Midwest Safety Conference of the National Council in Chicago, March 19, 1929.

With special reference to West Texas crudes, hydrogen sulphide (H_2S) occurs in solution with oil or is formed later through decomposition of sulphur compounds during the distillation of the crude or its derivatives in the various processes.

Hydrogen sulphide is a colorless gas having the characteristic odor of rotten eggs and is sometimes termed "rotten gas." It is 1.2 times heavier than air and because of this, it obviously has a tendency to settle in low places or poorly ventilated areas. It is extremely poisonous, acts as a soporific, and is very corrosive to some metals. In other words, in high concentration one breath may be enough to paralyze the sense of smell and cause immediate unconsciousness. A few more breaths paralyze the breathing center and stop the heart action. As high concentration paralyzes the sense of small instantly, there would be no warning from odor in this case.

Hydrogen sulphide reacts readily with iron to form iron sulphide. In some cases this reaction is advantageous because the gas may be neutralized by contacting it with steel shavings, etc. On the other hand, it is a great disadvantage because if not neutralized by other means it unites with the iron of various pieces of apparatus with resultant weakening until a safety hazard is involved through the possibility of failure of the metal under pressure, or operating conditions. Iron sulphide, if exposed to air, oxidizes very readily, and this oxidation may be so rapid that a glow may ensue, or sparks may be given off. If this occurs in the presence of an explosive mixture of vapor and air, a serious explosion or fire may occur with attendant jeopardy to life and limb. The most common methods of neutralizing is the reaction of hydrogen sulphide with caustic soda or soda ash. These reagents are prepared in solution and injected directly into the crude or vapors containing hydrogen sulphide.

PRACTICAL APPLICATION OF SAFETY PRECAUTIONS AT VARIOUS PROCESSES

A considerable amount of high sulphur crudes or crudes containing hydrogen sulphide is transported by pipe line and smaller amounts are transported by tank car. In the first case the gas is ever present at all points where the crudes discharge into tanks, since the hydrogen sulphide escapes through the tank vents with the lighter hydrocarbons. In the second case the same hazard exists, and in addition, the opening of tank cars for gauging and sampling also creates another source of liberation of the poisonous gas. In both instances all workmen, such as pumpers, gaugers and pipe fitters

are apt to breathe the gas unless strict precautions are taken. Generally it is not practicable to neutralize the gas at this point, however, various mechanical means of confining it are taken. In many instances floating roof tanks which minimize evaporation and weathering are employed and the amount of gas escaping is so negligible that a serious hazard may not exist. However, cases are on record where concentration became appreciable when the floating roof was at low gauge and men have been overcome when descending upon these roofs. Gas masks are generally used when gauging floating roof tanks or when removing dome covers from tank cars, etc.

In the crude tank farms where the crude is stored for indefinite periods, the hazard exists in about the same way, and has been handled chiefly in the way mentioned by employing floating roof tanks and the wide use of gas masks. The general experience in this line, however, is somewhat conflicting, because some tests have shown that the concentration is below the critical point or would not affect the gauger or person involved. On the other hand, cases are on record where injury has resulted, and to be entirely safe the utmost precaution is taken. In one attempt to get data on this subject, white rats were put on floating roof tanks containing West Texas crude. The rats were kept for a month on several different tanks, during which time practically all conditions as to height of roof, temperature, wind velocity, humidity and pressure were encountered, and none of the rats were affected, except one, which crawled down partially between the roof seal and tank wall. This rat was found dead. These results might indicate that any poisonous vapor escaping from the tank vents dissipates quickly enough to prevent undue concentration. This theory, as mentioned before, was thrown out, in view of the fact that in some cases it evidently did not hold true.

The danger of pyrophorous iron sulphide is ever present in all tanks containing high sulphur crude, and much work has been done on suitable protective coating as a means of saving metal and avoiding the hazard of explosion and fires. Several kinds of paints have been found suitable for this purpose and are used quite generally.

In the topping process or the distillation of crude at normal pressure the hydrogen sulphide in solution, as well as some which is formed through decomposition, escapes from the vents of the various condensers, while some is held in solution in the various distillates and gasoline. The amount escaping, if no neutralizing agent were used, would endanger life and deteriorate the equipment rapidly. For this reason liberal amounts of caustic soda solution are injected into the crude oil after it passes to the heating zone in order to neutralize as much of the hydrogen sulphide as possible. The endeavor, of course, is to neutralize all of it as quickly as it is formed, but because of imperfect contact of reagents it is quite impossible. In many cases a large excess of reagent has been used without thoroughly neutralizing all the hydrogen sulphide present. Additional caustic soda solution is injected into the vapor lines before the vapor reaches the gasoline condensers. Aqua ammonia is introduced into the vapor streams at the entrance to the fractionating system chiefly to neutralize hydrochlorite acid formed, but no doubt to some extent this also helps to neutralize hydrogen sulphide.

The net result is to greatly decrease the quantity of hydrogen sulphide in the gasoline and distillates. Some which is not neutralized escapes with the uncondensed gases which are compressed and delivered to an absorption plant, where further treatment may be made in either process. All equipment through which the gasoline and gas passes is designed with special attention to its tightness so that gas may not escape in areas in which operators work. Even with the utmost precaution, however, this sometimes occurs and the operators are warned continuously to be ever on the alert to correct any unsatisfactory condition that may arise.

The untreated gasoline produced still contains some hydrogen sulphide in solution, and the same hazard in handling this product exists, as mentioned for the crude storage. Most of these tanks are generally equipped with floating roofs to minimize evaporation and the same precautions in gauging as for the crude tanks is practiced. On the operating units, danger of pyrophorous, or glowing iron sulphide, is also present, especially when the equipment is open for inspection and repairs, and several cases are on record where fires have resulted from this phenomenon. As an added precaution it is the general practice to wash any equipment thoroughly with water, or steam it out, before opening it for repairs, and especially before anyone enters it for repair work.

In the cracking process or the decomposition of oil at high temperatures and pressures, the presence of hydrogen sulphide not only presents a hazard from breathing the poisonous gas, but the corrosive action on plant equipment occurs at such a rapid rate that safety measures must be enforced very rigorously to prevent equipment failures, which could and might, result in serious personal injury.

For the most part mechanical means have been employed to alleviate the attendant hazard, although chemical treatment is used quite generally. In the course of the oil from the cracking units to the treated oil storage tanks, the most volatile products are kept enclosed in gas tight enclosures. This has been accomplished by well made up piping and a gas recovery arrangement for tanks, including an absorption plant, whereby the gas that ordinarily might escape to the air is collected and disposed of as fuel at some of the furnaces after having been stripped of gasoline.

Washing the cracked distillate with a solution of caustic soda during its discharge from the unit into rundown tanks greatly minimizes the hazards encountered. In the cracking process, greater amounts of hydrogen sulphide are encountered than in other processes because of the high temperature and pressure employed with resultant decomposition of sulphur compounds. Therefore, the gauging and sampling of oil in receiving tanks presents a greater hazard than at most any other point in the refinery. However, the degree of danger has been reduced by equipping the tanks with gauge glasses and sampling lines to avoid the necessity of exposing the gaugers to the gases, which happens if gauging and sampling is attempted through open gauge hatches such as practiced when handling

other types of oil. Most of these tanks are so equipped that it is very seldom necessary to open the gauge hatch for any purpose, and when it does become necessary, the use of the gas masks by the workmen is required and enforced.

The fixed gas that must be handled from the cracking units separately from a distillate does not present a problem of such proportion as the distillate, for the reason that it is handled through pipe lines to the point of disposition, which is usually in the furnaces. However, extreme precaution is exercised so that no leaks develop to allow the gas to escape in quantities sufficient to cause injury. This is particularly true where the piping passes through the unit control house. As an added precaution, the houses are kept well ventilated by leaving windows and doors open at all times.

The hazard attendant to corrosion of plant equipment, rendering it unsafe, has been reduced to a great degree, but still is a serious problem. Frequent inspections and pressure tests have been successful in showing up weak equipment. Where possible and practicable, parts of plant equipment exposed to the corrosive action of these gases have been protected by covering the exposed surfaces with linings so that the metal of the equipment itself is affected as little as possible. The corroded or damaged linings are generally replaced when their weakened condition warrants it. It is also the tendency at the present time with some equipment to construct it of sufficient strength to allow for considerable corrosion before it becomes damaged or weak.

In injecting lime into the cracking unit with the oil feed has to some degree lessened the corrosion rate of the plant equipment.

SAFETY RULES AND REGULATIONS

As the name implies, the safety department has to do with assimilating the necessary information to be posted in conspicuous places around the refinery, and in some instances to see that each individual is furnished with the necessary literature to keep him well informed as to the hazards attendant to his particular job. In addition to this a trained safety engineer makes frequent inspections of the whole refinery, observing the various practices as they are followed out and, on the whole, devotes his total time to the improvement of conditions for the lessening of hazards. Safety meetings are held very frequently, in which the operators from various sections of the plant are present, and it is the intention to draw their personal opinion of conditions so that preventive measures may be formulated. The safety also make it a point to discuss these matters with the various department heads, in order that all issues are kept alive at all times, and that no inertia or weakening of the enforcement of existing rules may develop. For the particular problem at hand, the following bulletin governs the general precautionary measures and this is supplemented by an additional amount of minor bulletins, safety posters and verbal propaganda.

1. The handling of sulphur crudes from tank cars through the pumps to storage entails some hazards due to leaking valves, packing glands, and fittings; also the gases present in tank cars and storage tanks at hatches and gauge wells. Therefore, the operators at the loading rack, pump houses, and all gaugers were warned regarding the possibility of coming in contact with hydrogen sulphide gas in such locations.

2. Pipe fitters are warned to be cautious when hooking up bottom connections of cars preparatory to unloading.

3. Unloaders are warned to be cautions when removing dome covers. The discharge valve must be opened, as there is generally an accumulation of H_2S, between the oil level and tank car top, which has been liberated from the crude while in transit.

4. Employes are instructed not to stand on the side of any opening where escaping gas will blow towards them.

5. Gaugers and sample carriers are especially warned to keep to the windward side of gauge and thief holes.

6. When gauging or taking samples at any place where it is known that hydrogen sulphide gas is supposed to be present, or the ordinary symptoms are noticeable, a hose mask or acid canister mask must be worn.

7. Wherever possible, the hose mask, equipped with a blower, must be used, the precautions should be taken to make certain that the blower is placed in gas free air, preferable on the windward side of the source of gas.

8. Steam aspirators were installed in the look boxes to discharge all gases and vapors into the atmosphere.

9. Employes are warned to exercise care when working in or around equipment that is being, or has been, used for the running of Panhandle or West Texas crudes and pressure distillates. No one should try to determine the presence of H_2S by its odor. For example, when it is necessary to enter a tank that has been used for storage of such crudes or pressure distillates, a test of the air in the tank must be made to ascertain if H_2S is present. If the test indicates presence of H_2S, the employe must put on a hose mask before entering the tank.

10. Lead acetate paper is used to determine whether or not H_2S is present in all tanks and stills before employes are permitted to enter and work in such tanks and stills.

11. Frequent tests with lead acetate paper are conducted in and around the various units running sulphur crudes.

12. All pressure distillate rundown tanks are equipped with gauge glasses, which extend the full height of the tanks, also sample cocks; this makes it unnecessary to go on top of such tanks to obtain gauges or samples.

13. All traps, sewer boxes, catch basins, blow-off pits and separators are tested for H_2S before workmen are permitted to work in such places.

14. When floating roof tanks are in service, employes are forbidden to go down on the tops of floating roof tanks, unless they are equipped with a gas mask, and a fellow worker is stationed at the top of the ladder or stairway to render assistance to the man on the roof if necessary.

15. When cleaning or repairing tanks, employes are required to observe the following safe practices:

(a) All lines shall be disconnected and blinded to prevent leaky valves or fittings admitting dangerous gases to the tank.

(b) All manhole covers shall be removed to permit free circulation of air.

(c) All tanks shall be steamed until gas free before

any work is started, and a steam or air aspirator located in the upper manhole shall be operating at all times when work is being done on or inside of tanks.

(d) Before entering or working upon tanks, three independent bottle explosion tests, or laboratory tests, shall be made by a competent person to determine the hazards, if any, from inflammable mixtures. This procedure shall be repeated periodically as the air conditions may change often during the day; due to heat, agitating of tank bottoms, etc.

(e) Lead acetate paper shall be used to determine the possible presence of hydrogen sulphide, or petroleum gases, and if any marked degree of discoloration is noticed, workmen shall not enter until further steaming of the tank removes the hazard. These tests shall be made periodically at short intervals, until the work within the tank has been completed.

(f) Men entering tanks which are to be cleaned shall be equipped with a hose mask of the blower type, also a life belt and line. The blower, which furnishes the air to the masks, must be located in pure air, preferably to the windward side of the tank.

All operators, and approximately 50 per cent. of the balance of the refinery force, have received instructions in the Schaefer method of artificial respiration and the use of the H. H. Inhalator. These instructions are given to approximately 10 per cent. of the operating and maintenance employes every two months; instructions being given to different groups each time.

Two portable H. H. Inhalators and one hospital H. H. Inhalator are kept available and ready for use at all times to resuscitate anyone who may have come in contact with the gas and was overcome.

It is felt that a considerable amount of educational work, as well as practical application of precautionary measures, should be carried out. When one considers the serious hazards which might exist if these measures were not taken, it is very obvious that the effort is not only well worth while, but is imperative. The cases of injury resulting from this hazard have been very few and in each case an object lesson has been brought out to strengthen the existing regulations for the avoidance of recurrences.

Problems in Steam Engineering*

By T. F. WILLIAMS

IN arranging a piping system for a steam plant, the aim must be to produce a design that combines low first cost with durability and serviceability; the ease with which the piping can be taken down for repairs must also be considered. In general, flanged sections are more easily taken down than sections united by screwed joints; at least in the larger sizes. The question of whether to place the piping over head or under the flooring is chiefly one of convenience and appearance. With the piping under the flooring, the engine room will generally look better, but the piping will not be as accessible as when overhead.

Careful thought is necessary in designing piping connections to boilers. Connections between a single boiler and the distributing main, are comparatively simple to make; but when two or more boilers are to be connected to the same main line of pipe, special or adequate provision must be made for expansion; otherwise, the stresses on the connections caused by expansion and contraction, will cause them to leak. If a long line of pipe is connected directly to the boiler shell, the expansion due to the entrance of hot steam will so increase the length of the pipe as to twist or wrench the joints.

Several approved methods are used to connect a boiler to a steam main. The two methods, chiefly used are the use of 90° or U bends, and the swing or swivel expansion joint.

The linear expansion and contraction of the main steam line is also taken care of by either a slip joint or swivel joint, or a corrugated expansion joint.

*Read before the foreman's meeting of the Columbian Gasoline Corporation.

The linear expansion or contraction of a pipe line may be found by the following formula.

$$M = C\ L\ T$$

M = Amount of linear expansion or contraction, in inches.

C = Coefficient of linear expansion.

L = Length of piping, in inches, before the change of temperature occurs;

T = Change of temperature in degrees F.

The value of C for wrought-iron or steel pipe is .00000599; for cast-iron pipe, .00000617; and for cast-steel pipe it is .00000636.

Example.—A steel pipe line 128 feet long is put up at a temperature of 60°. When it is finished, steam at a maximum temperature of 350° is turned on.

Find the linear expansion.

Solution:—Apply the formula just given.

The pipe is of steel, and so $C = .00000599$; $L = 128 \times 12 = 1536$; and $T = 350° - 60° = 290°$. Substitute these values, and $N = .00000599 \times 1536 \times 290 = 2.66$ inches expansion.

STEAM HEATER PRACTICE

Practical experience has taught that it is best to use two valves on the steam header, one near the main and the other at the boiler. The one near the boiler should be a non-return valve; the object is to prevent, automatically, the blow of steam from one boiler to any boiler that might be disabled. Gate valves are not suitable for this kind of emergency work, as they require considerable time to close, and may be difficult to move when nearly closed.

When several boilers of say, 200 horsepower and

upwards are used, it will be found convenient to place the steam main or header on or near the floor in the rear of the boilers, this brings all of the large valves in accessible positions.

When determining the size of the steam main to take care of the flow of steam from a battery of boilers, it is not necessary to have the header the same size throughout; in fact, from an economical view point it is best to calculate the size of pipe required to handle the discharge from one boiler, then two boilers and so on, until you have a size that will take care of the discharge from all the boilers. If all the boilers in the battery are of the same capacity, the calculation of the diameters of the section between each boiler is a simple matter.

Suppose that a battery has four boilers, designated, from right to left, as A. B. C and D., and each boiler being of the same capacity has a discharge pipe of four-inches in diameter. In this case the header section from A. to B. would be four inches in diameter; the header section between B. and C. will have to carry the steam discharge from A. and B. combined, so in order to calculate the diameter of this section you must extract the square of two, because there are two boilers connected to this section, and multiply by the diameter of the first section, which was found to be four inches.

Following is the rule of determining the diameter of each head section:

Let diameter of section from A. to B.=D.

Let diameter of section from B. to C. = D. $\sqrt[2]{2}$.

Let diameter of section from C. to D. = D. $\sqrt[2]{3}$.

Then the diameter of main line = D. $\sqrt[2]{4}$ = D. $\times 2$ or $4 \times 2 = 8$ inch diameter.

To prevent loss of heat by radiation, the steam pipes should be covered with some kind of material that is a poor conductor of heat.

The substances used for covering steam pipes for this purpose are very numerous and vary considerably in efficiency. Among the best and most widely used non-conducting materials are hairfelt, cork, magnesia, asbestos, and mineral wool. As a rule the covering is manufactured in short sections molded in halves to fit the pipe, the valves and fittings being covered with the same material in a plastic state. After the covering is properly secured in place, it is frequently covered with a heavy duck or canvas jacket sewed on and painted, and sometimes ornamented by brass bands placed at regular intervals.

WATER HAMMER

Water hammer is another important factor, that is very necessary to be looked after.

The presence of water in a steam pipe is the cause of water hammer.

When a steam line is installed it should be so arranged that water pockets will be avoided, and where such pockets are unavoidable, they must be drained.

It has been shown experimentally that the pressure produced by water hammer may be as great as 10 times that which the pipe is expected to sustain in its regular work. In some cases, water hammer has caused boiler explosions by bursting a steam pipe and thus relieving the boiler pressure so suddenly that a large quantity of water flashed into steam.

In order to separate the entrained water from the steam, it is necessary to use separators. Baffle plate or contrifugal separators will do the work.

The separator should be installed on the steam main at the discharge end about four feet back from the first auxiliary steam pipe leading to the engines.

A steam trap connected to the bottom of the separator removes the accumulated condensation, without allowing steam to escape.

The velocity of steam in the main, varies according to the size of pipe. The pipe size generally used in connection with the transmission of saturated steam are such as to give steam velocity of from 3500 to 6000 feet per minute. In reality the velocity of flow of no particular consequence so long as the required capacity can be obtained without exceeding the allowable drop of pressure. The allowable drop of pressure may be from one to five pounds per 100 feet of length of straight pipe.

FLOW OF STEAM

There is a definite relation between the weight of steam delivered and the drop in pressure at the discharge end.

The number of pounds of steam that will flow continuously through a pipe of given diameter in one minute at a specified pressure may be calculated by the following formula:

$$\text{Weight} = 87 \sqrt[2]{\frac{w\,(P_1 - P_2)\,D^5}{L.\,(1 \text{ plus } \frac{3.6}{D})}}$$

W = Weight of 1 cubic foot of steam of pressure P.

P_1 = Pressure of steam at entrance of pipe.

P_2 = Pressure of steam at discharge of pipe.

L. = Length of pipe in feet.

D. = Diameter of pipe in inches.

The valve of w. may be taken from the table below.

Absolute press. lbs. per sqin.	Weight of cu. ft. of steam in lbs.
100	.2271
105	.2378
110	.2484
115	.2589
120	.2695
125	.2800
130	.2904
135	.3009
140	.3113

Example:—How many pounds of steam will be discharged per minute with an absolute pressure 125 pounds through a pipe eight inches in diameter and 100 feet long, with a drop of pressure of five pounds.

Solution:—Substitute the values found and apply the formula just given.

$$\text{Weight} = 87 \sqrt[2]{\frac{.2800 \times (125 - 120) \times 32768}{100 \times (1 \text{ plus } 3.6 \text{ divided by } 8}} = 87 \times 17.8 = 1548.6 \text{ pounds per min.}$$

Accident Thinking

By OTTO PETERS
Superintendent Hanlon Gasoline Campany

THE dictionary defines accident as "an event which is unexpected." An injury brought about by oneself is not an accident. I would rather have a man report he had hurt himself than report he had had an accident. Accident is the effect of a cause, the cause 98 times out of 100 being thoughtlessness. My knowledge of accidents is based upon experience and observation and not upon statistics. My thought is upon the fact that time and again we see the man most familiar with his work hurt himself. Again and again men hurt themselves in the same manner. Why is it that some men hurt themselves more often than others do?

The employer is spending money and making all efforts to safeguard all things that can possibly be construed as dangerous. He does everything under the sun to eliminate hazards in any form, from the placement of extra lights to the employment of extra men. Each injury is traced down to find its cause and then efforts are made to prevent its recurrence. Meetings are held to discuss safety practice, pictures are shown, talks are illustrated, instructions are issued, but the fact remains that defective tools are still being used, shoes are still unsoled, goggles are not used and indifference on the part of the employee still exists, ignoring the fact that safety is an individual responsibility.

I am impressed with the fact that the ambition of all wage earners is to increase their salary earnings. This is a fundamental ambition for the benefit of their dependents, yet this ambitious worker is apt not to think of the economic loss in the event of his injury. I fear that men do not think of the untold suffering, the agony of suspense and worry on the part of the wife and children when the wage earner is laid up. I can not express in writing the tragic evpression I have seen on the face of the wife when taking home the injured husband. The employee who meets with injury suffers pain and financial loss, the hardship to his family can not be estimated. It is an established fact that to his company he costs $4 to each dollar of his accident cost, plus the harmful attitude of resentment toward the company on the part of himself and family, however unjust it may be, and this resentment many times finds expression in lawsuits.

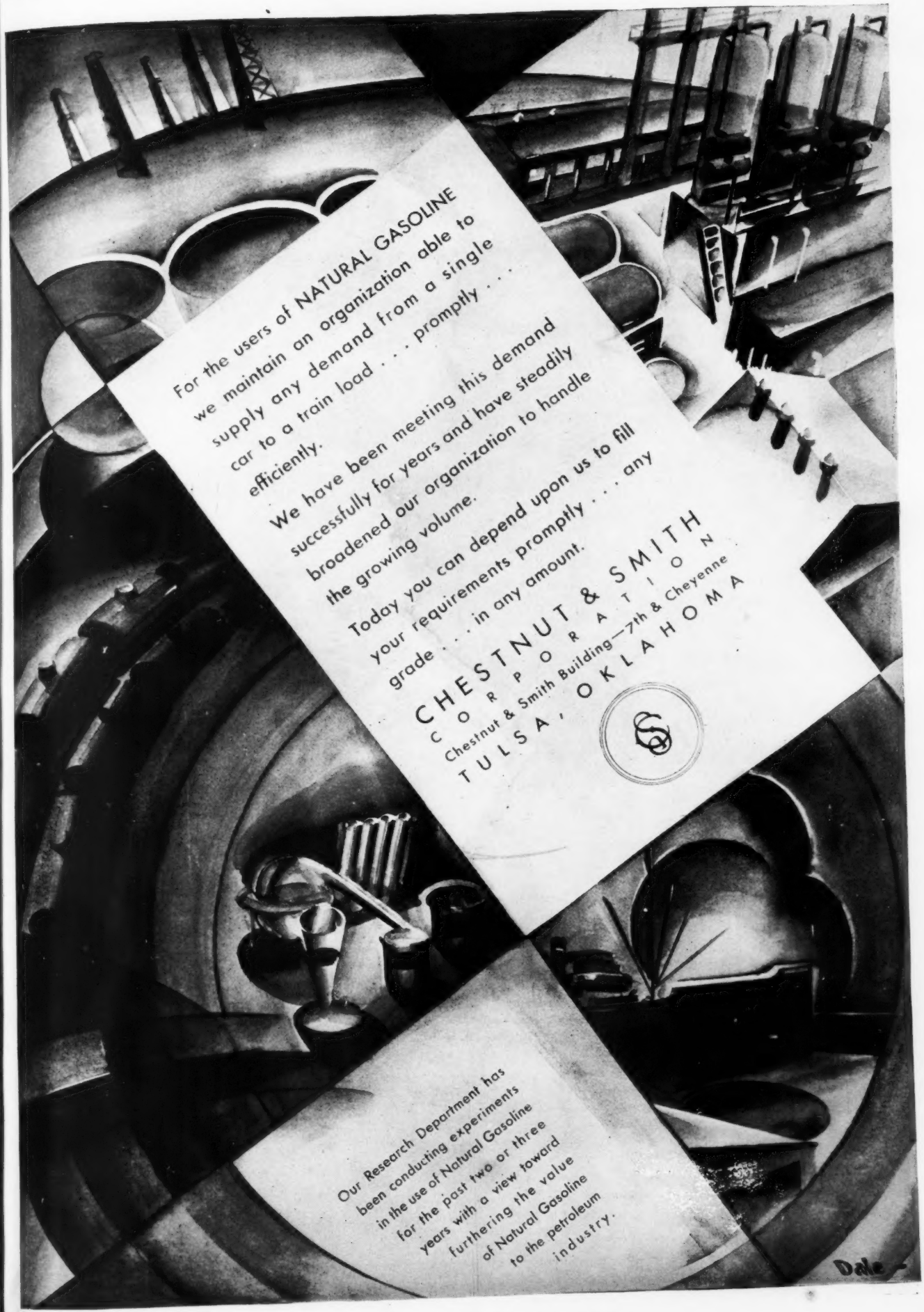
The first remark of the one who has hurt himself is that he did not think. Ninety-eight per cent. of all accidents are due to not thinking. Nails in the feet, a screwdriver in the palms of the hands, splinters in the eyes, reckless driving, all these things indicate lack of thought and it follows that in connection with the present method of teaching accident prevention, the habit of thinking about accidents has to be taught. It is not enough to show the corrective measures taken in placing of safeguards because the same man who caused the guards to be placed will meet with the same injury if he works at another place where the guards are not used.

I fear no contradiction when I say accident thinking must be taught. I question how many men give thought to the functioning of their conscious and subconscious minds. I fear no ridicule in saying there is no such thing as forgetting. I must admit we forget, but that is because we do not train our minds. How easy it is to visualize that our mind has two compartments and that in each compartment there are millions of servants to do our bidding, one to accept each impression and to carry it to another one who retains it, subject to our call as we need it. How many men in their daily work anticipate accidents, I do not mean fear of accidents, I mean do they stop a moment to think accident, does the foreman hesitate long enough to make sure of his ground, sure of his men, does he give that needed word of caution.

There is one way to teach accident thinking. I recommend that employers allow their employees, in departmental groups, one day a year to visit the ward of a hospital, and when they see the broken arms, the broken legs, the disfigured bodies, the misery and the helpless suffering they will experience through sight and feeling the emotions of fear, faith, hope and charity, and most assuredly they will make the effort to prevent accidents, to themselves and to their fellow workers.

The reduction of industrial accidents in recent years is an outstanding achievement. In connection with the elimination of hazards by installation of mechanical safeguards, the need of safety supervisors was recognized and then also was recognized the individual responsibility of the employee. The same lack of thought that causes one to hurt himself causes him also to hurt the machinery. The employer then looks upon an accident as affecting human life and the life of mechanical equipment. His insurance is based upon humanitarian necessity and also as a business investment on the part of good management, and where his insurance supposedly protects his machinery and his employee, the facts are that he pays the cost of injury to either one. Now that advancement has been made to protect mechanical equipment, the protection of the employee is essential, and where statistics show that 98 per cent. of so-called accidents are due to the individuals lack of thought, compulsory measures will be called upon to make him think.

Indications at present are that, drastic medical examinations have to be passed, age limits are set, salaries are forfeited, and the individual's number of accidents is checked against him for future reference regarding his possible promotion or continuance in service, furthermore the law sets a stipulated compensation for each and every injury. The time is at hand when the individual responsibility of accidents must be recognized and lived up to, and the greatest aid to this is cooperation in every form in every instance, particularly when the effort is made by adhering to a well laid plan of accident prevention.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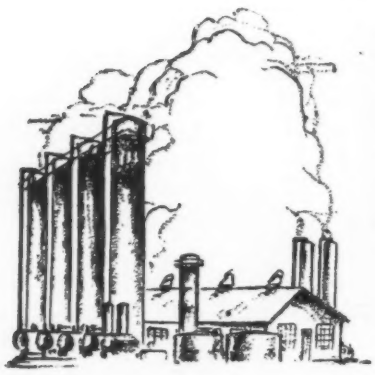

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Natural Gasoline Association of America Meets May 21, 22 and 23

FOR its eighth annual convention in Tulsa, May 21, 22 and 23, the Natural Gasoline Association of America will consider a program, devoted largely to the handling and selling of natural gasoline. The program will revert to a session of three days. In 1928 only two days were given to the program, with the third day for a visit to natural gasoline plants of the Seminole area.

The morning of the first day will be devoted to routine matters of the organization, including the annual address of the president, H. A. Trower of the Phillips Petroleum Company; the address of welcome by F. L. Chase of the Lone Star Natural Gas Company; appointments of committees and reports of committees already existing.

The annual election will come the first day. The nominating committee already has been named, consisting of F. E. Rice of the Phillips Petroleum Company; E. L. Peck of the Empire Oil & Refining Company, and D. E. Buchanan of Chestnut & Smith Corporation.

Arrangements for the convention have been made largely by Ray E. Miller, who will serve as secre-

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PROGRAM EIGHTH ANNUAL CONVENTION
NATURAL GASOLINE ASSOCIATION
OF AMERICA, MAY 21-23, 1929

Tuesday, May 21

Forenoon

F. L. Chase, chairman.
Welcoming Address—F. L. Chase.
President's Address—H. A. Trower.
Appointment of Committees.
Reports of Committees.

Noon

Dutch Lunch—Natural Gasoline Supply Men's Association.
W. A. Melton, Chairman.

Afternoon

Paper—A Review of Fires and Explosions that have occurred in the industry over the past few years—By Emby Kaye, Skelly Oil Company.
Discussion—A. M. Coulson, Sinclair Oil & Gas Company.
Paper—Procedure Necessary to Manufacture and Ship Gasoline Acceptable to the Existing Natural Gasoline Market—By A. T. Scherer, Sinclair Oil & Gas Company.
Discussion—S. B. Crooks, Empire Oil and Refining Company.
Paper—Repressuring and its Effect on the Natural Gasoline Quality—By Edward Foran, Saxet Oil Company, Houston, Texas.
Discussion—E. F. Ouidinger, Phillips Petroleum Company.

Evening

Stag Smoker—Natural Gasoline Supply Men's Association.

Wednesday, May 22

Forenoon

D. E. Buchanan, Chairman.
Progress Report on the Research Program of the Natural Gasoline Association of America, Dr. George G. Brown, University of Michigan.

Noon

Dutch Lunch—Natural Gasoline Supply Men's Association.

Afternoon

Continuation of Report by Dr. George G. Brown.
Discussion—Led by D. E. Buchanan, as chairman of the session.

Evening—No Program

Thursday, May 23

Forenoon

A. J. Schlosser, Chairman.
Paper—Gasoline Storage Practice in the Natural Gasoline Industry, by G. M. Davidson, Empire Oil & Refining Company.
Discussion—A. J. Schlosser, Barnsdall Oil Corporation.
Paper—Is Present Gasoline Storage Adequate to best Serve the Industry? By J. M. Sands, Phillips Petroleum Company.
Discussion—A. F. Wood, Chestnut & Smith Corporation.

Noon

Dutch Lunch—Natural Gasoline Supply Men's Association.

Afternoon

Paper—The Practical Application of Gas Analysis to the Operation of Gasoline Plants, W. W. Robinson, Jr., The Texas Company. This paper is to be prepared by Messrs Robinson, P. S. McGruder, General Petroleum Corporation; J. C. Burks, O. C. Fields Company, and E. R. Cox, The Texas Company.
Discussion—R. O. Campbell, Skelly Oil Company.
Paper—Report on the Work of the Technical Committee of the Natural Gasoline Association of America. By G. G. Oberfell, Phillips Petroleum Company.
Discussion—R. E. Baker, Shell Petroleum Corporation.

Evening

Dance—Supply Men's Association.

tary for the first time at a convention. He joined the organization in that capacity in December, 1928, following the resignation of A. V. Bourque, who had held the place since the association was formed.

The board of directors has been active in carrying these arrangements through. Committees from the board and from the membership will be named to complete all details of the meeting.

Officials of the organization are H. A. Trower of the Phillips Petroleum Company, president; Dr. E. R. Lederer of the Texas Pacific Coal & Oil Company, vice president; George L. Ratcliffe, vice president; Ray E. Miller, secretary. S. C. Carney was vice president previous to his removal from Tulsa to San Francisco early this year.

The three elected officials are members of the board of directors, which has the following additional members:

H. B. Bernard, Sinclair Oil & Gas Company, Tulsa;

D. E. Buchanan, Chestnut & Smith Corporation, Tulsa;

George A. Burrell, Burrell Oil & Gas Company, Pittsburgh;

F. L. Chase, Lone Star Gas Company, Tulsa;

W. N. Corbet, Eagle Picher Lead Company, Henryetta, Oklahoma;

Earle Derby, Standard Oil Company of California, Los Angeles;

R. R. Filley, The Texas Company, Tulsa;

F. C. Hall, The Henderson Company, Tulsa;

W. F. Hartwig, The Palmer Corporation, Shreveport;

L. B. Jackson, Oklahoma Gasoline Plants, Inc., Tulsa;

Emby Kaye, Skelly Oil Company, Tulsa;

S. F. Magor, United Fuel Gas Company, Charleston;

W. A. Melton, Shaffer Oil & Refining Company, Tulsa;

M. E. Mockley, Amerada Petroleum Corporation, Tulsa;

E. L. Peck, Empire Oil & Refining Company, Bartlesville;

J. A. Rafferty, Carbide & Carbon Chemicals Corporation, New York;

F. E. Rice, Phillips Petroleum Company, Bartlesville;

Charles Roeser, Roeser & Pendleton, Fort Worth;

A. J. Schlosser, Barnsdall Oil Corporation, Tulsa;

O. H. Schoenwald, L. H. Wentz, Oil Division, Ponca City;

E. A. Titsworth, Prairie Oil & Gas Company, Independence;

D. C. Williams, Marland Refining Company, Ponca City;

S. S. Smith, Shell Petroleum Corporation, Tulsa.

Supply Men Will Furnish Convention Entertainment

ALL entertainment for the eighth annual convention of the Natural Gasoline Association of America will be sponsored by the Natural Gasoline Supply Men's Association. Committees were named early in April to provide the several events, which will come in connection with the convention in Tulsa, May 21, 22 and 23.

The organization of supply men was made permanent prior to the convention in 1928, after being started the year previous, when several concerns met and took charge of part of the entertainment. The supply men have been called into sessions with the directors of the Natural Gasoline Association of America in the preparation of the convention program.

The entertainment will consist of a lunch each of the three days, a stag smoker the evening of the first day and a dance the evening of the final day of the meeting. This will leave one evening open.

Directors of the Natural Gasoline Supply Men's Association met April 9 and perfected plans for the convention and also took action on several matters within their own organization. It was decided that the books would be closed May 10 to membership for this year. Concerns, which wish to take part in the events of the coming convention will be required to comply with all membership requirements by that time. Ray E. Miller, who is secretary of the Natural Gasoline Association of America is also secretary of the affiliated organization of supply men and will handle memberships. An effort will be made to increase the membership, which stood at 41 April 1.

Officials of the Natural Gasoline Supply Men's Association are J. H. Satterwhite, Westcott & Greis, Inc., president; W. A. Schleuter, Refinery Supply Company; and M. F. Waters, Smith Separator Company, vice-presidents; D. W. McKay, Hope Engineering & Supply Company, treasurer.

Entertainment for the annual convention will be handled through committees which were named April 9.

The comimttee on the smoker and its entertainment consists of W. Woobank, Woobank Pump and Machinery Company, chairman; M. F. Waters, Smith Separator Company, and W. G. Cummings, Gas Engineering and Supply Company.

The three lunches will be under the supervision of a committee of W. D. McKay, Hope Engineering and Supply Company, chairman; P. P. McKirihan, Continental Tank Line and J. W. Satterwhite, Westcott and Greis.

The dance will be arranged by a committee of M. F. Waters, Smith Separator Company, chairman, W. D. Emory of B. V. Emory & Company, and W. Woobank of the Woobank Pump and Machinery Company.

The committee to provide badges, tickets and favors consists of W. A. Schleuter, Refinery Supply Company, chairman; B. V. Emory and W. Woobank.

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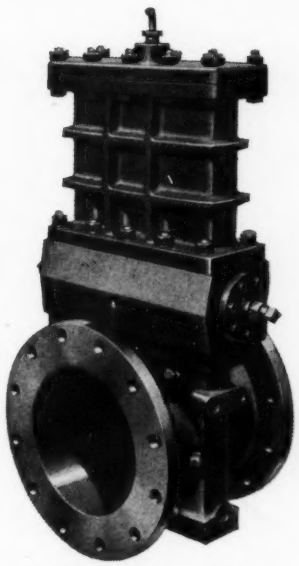

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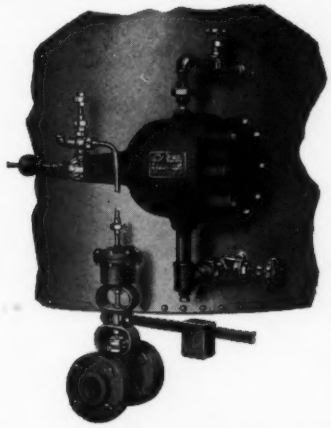

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Maintains constant level under all conditions of temperature and pressure. May be used to control the outlet or inlet flow.

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IF you wish to hold back any pressure between 300 and 800 pounds,—and have a *continuous* discharge

(a) into a distributing system having close to atmospheric pressure or
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Or if an auxiliary pressure for operation of the regulator is desired—

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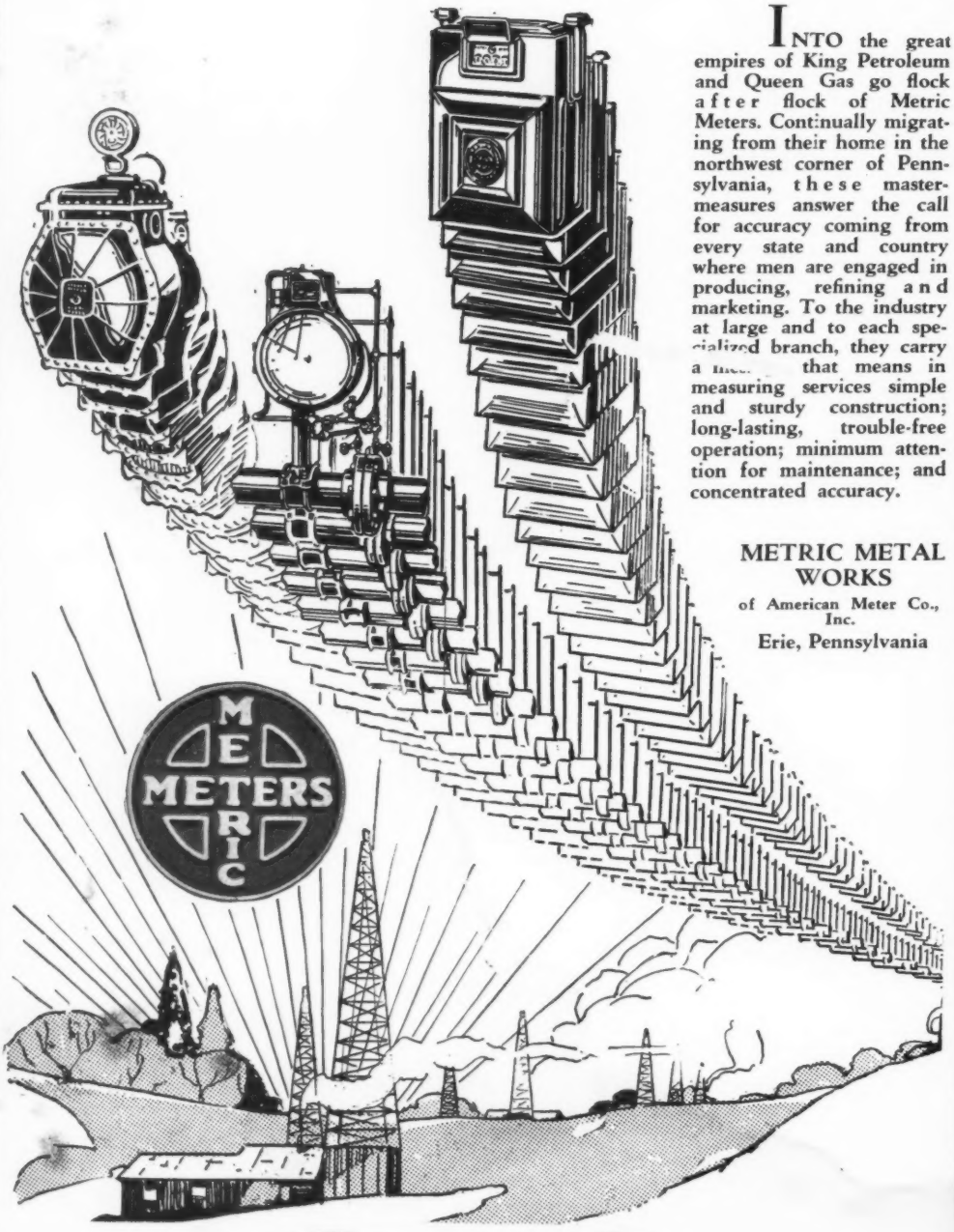

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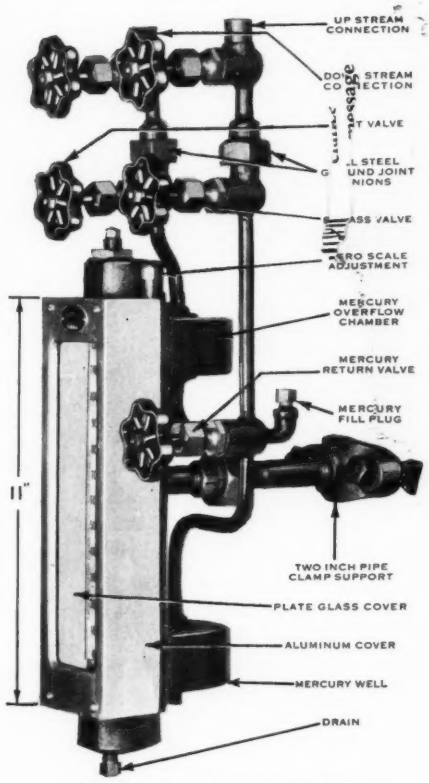

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Ends of glass tube inserted in steel packing glands. Frame of molded aluminum. Scale etched on silver finish aluminum. These Special Gland Packed Manometers are adapted for taking the Differential and for Vacuum as well as for Pressure readings.

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MEASUREMENT AND CONTROL

EASTERN REFINERS SPRING MEETING

Eastern Refiners Turn Attention To Gasoline

MARKETING, economics, and manufacturing problems were all emphasized at the spring meeting of the National Petroleum Association at Cambridge Springs, Pennsylvania, April 25-26. A more complete and more eagerly supported system of exchanging detailed information relative to refinery operations and production, and the full endorsement of the American Petroleum Institute Code of Ethics, were discussed with interest as possible means of assisting in solving the problems peculiar to the Appalachian refining district.

The sense of the convention might well be summed up in the statement that Appalachian refiners should consider gasoline as a major product and not as an incident to the manufacture of lubricants. This gasoline should be vigorously marketed in territories which can be reached by tank car with freight rates comparable with rates from Group 3 and other refining centers. Further, this gasoline should be manufactured in such manner that it will be equal in quality from an anti-knock standpoint to motor fuels from other crudes, since the motorist is demanding fuel which will not detonate.

E. M. Lyons, president of the association and president of the Tiona Refining Company, in his opening address presented the situation as follows: "Gasoline can no longer be considered a by-product by the Pennsylvania refiner whose interest in the past has been centered in the manufacture of lubricating oils. Pennsylvania crude at $4.00 a barrel and low priced lubricants available in outside refining areas are going to force us to recognize the fact that we are selling 75 per cent. of our products at a loss and depending upon the other 25 per cent. to carry the load."

The Department of Trade and Commerce, which is headed by N. H. Weber of the Pure Oil Company, had its work emphasized at the first session. Mr. Weber illustrated convincingly what a few simple statistics will do in helping to shape the future of the group of refineries represented. Knowledge of how the picture will look at the end of the year will often mean the difference between profit and loss. This paper and discussion was followed by L. L. Long, sales manager of the Waverly Oil Works, Pittsburgh, who read a paper on "Cooperation in and with the Department of Trade and Commerce." He further emphasized the need of a system of exchanging operating data among refineries which might well aid in averting periods of abnormally low prices for certain commodities which usually follow periods of overproduction. Economics were further brought into emphasis through papers delivered by N. H. Sanger, Pure Oil Company, and John D. Gill, Atlantic Refining Company. Mr. Sanger stressed the importance of predicting refinery runs in advance in correlation with probably increased consumption of products, under the title of "Peaks and Valleys." He showed, by a series of charts and graphs the "Peaks and Valleys" in regard to gasoline prices over a period of 10 years with the reasons therefor. Mr. Gill in his discussion, "More Profit from Less Waste" forcibly indicates the advantages to the Pennsylvania or Appalachian group of refineries in vigorously marketing their products within and close to the area.

P. S. Tarbox, Independent Refining Company, Oil City, trustee in charge of the Department of Manufacture was in charge of the session dealing with manufacturing. C. R. Wagner, assistant chief chemist, Pure Oil Company, read an interesting and valuable paper having to do with the history of development, problems of installation and operation, peculiar to the Gyro vapor phase cracking process which was developed in the refineries of his company. MacClean Houston, production manager for the United Refining Company followed with a discussion "Making Better Gasoline," in which he stated that his company was enabled to produce a valuable grade of gasoline from Pennsylvania crude through the employment of a fractionation method of improved efficiency.

In his paper, "Restoration of Fuller's Earth" Karl W. Nichols, Kendall Refining Company, stated that at the Kendall plant it had been found inadvisable to burn clay when its efficiency had been reduced to about 65 per cent. Herbert A. Ross, combustion engineer, in his paper, "The Cooperative Engineering Problem" stated that combustion conditions in the refinery are very difficult to improve unless the support of the men in the plant is successfully enlisted and they are themselves sold on the improvement program. Mr. Ross brought out many interesting points having to do with research in the coal and oil industries.

Thursday night the fellowship supper was held. L. C. Jamieson substituted for Fred G. Clark in charge of entertainment program. The Ohio Oil Company, The Standard Oil Company of Kentucky, Standard Oil Company of New Jersey, Solar Refining Company, Lima, Ohio, and The Standard Oil Company of New York, were welcomed into membership

EASTERN REFINERS SPRING MEETING

of the Association. Standard Oil Company of Ohio has been a member for the past two years.

At the Friday session which was in charge of the Department of Economics, Henry W. Ralph presented his paper, "Pricing the Inventory." This subject was discussed by M. A. Brewster, Pennzoil Company. Refinery wastes and the work of the Pennsylvania Department of Health was discussed by W. L. Stevenson, chief engineer for this state department, in connection with pollution of streams. The Pennsylvania plant was discussed, as well as anothter and more practical plan developed by the Department of Health. Mr. Stevenson asked the cooperation of the association along these lines. Fayette B. Dow, general counsel for the association, stated that they were very glad to be approached in this way and promised the cooperation of the industry in the matter of cooperation with the state in the solution of such problems.

"Self Preservation" was the title of a paper presented by R. A. Wotowitch, trustee in charge of the fire and safety marshals of the Association. He lauded the accomplishments of the group and solicited further cooperation from executives by stating that "unless they are stopped by their executives they will do much more good work." James H. Herbert, Standard Oil Company of Ohio, discussed the work of the groups and the cause of the fires which were reported during the past year. Standard Oil Company of Ohio invited all members of the association to visit its refinery at Cleveland on May 24, through J. S. Harrison, vice president in charge of refining. The invitation was accepted with thanks.

An interesting demonstration of the training in first aid work given in groups was presented. Two first aid teams, one from the Bradford district and one from the Warren district, competed in three problems for medals presented by O. P. Keeney, former president of the association. The contest was won by the Warren team.

Houston Dunn, general manager of the National Petroleum Mutual Fire Insurance Company, discussed "Contingent Liabilities." The afternoon session, Friday, was given over to traffic matters and was presided over by Willis Crane.

Cooperative Possibilities Develop in A Study of Combustion

By HERBERT A. ROSS
Combustion Engineer, National Petroleum Association

In my preparation of this paper, and the consideration of what I could say that would be of greatest value to you today, as a reward for the time you are forced to spend in listening to me, I feel that a presentation of the possibilities in further cooperative effort to reduce manufacturing expense might be of interest. It should be of considerable importance also, for if there ever was a time when full and correct information relating to every phase of petroleum refining in our especial field was needed, it is the immediate one.

What I shall say will be confined strictly to a statement of facts that can be substantiated by unquestioned authority, but you must understand that in giving you these particulars, I avoid any expression of personal opinion.

A group of members in this Association nearly four years ago undertook a cooperative experiment in combustion economics. The value of this adventure is proven by the statement that as of December 31, 1928, the coal and equivalent fuel burned per barrel of crude run in their plants has been reduced 69.5 pounds. In other words, the fuel consumption of some twenty-two representative plants was 196.5 pounds per barrel of crude run in 1925. In 1928 this consumption was reduced to 127 pounds per barrel in fourteen refineries. Extending over this three year period, the actual value of the fuel saved is $519,960.00. This saving in a fuel bill of over one-half million dollars in three years of cooperative effort is a concrete value. What about the intangible values of better yields and products; the improved mechanical condition of equipment and further extension of its useful life; the enhanced value of the "Human Machine" because he is better informed and can therefore work for you with greater intelligence? Isn't it reasonable to believe that such improvement is of greater monetary value than the fuel which has been saved? Cooperation has made this possible.

PROFIT THROUGH SAVING

What has been accomplished through cooperation in combustion most certainly emphasizes the value of cooperative effort. It is not claimed that saving fuel alone is a remedy for anyone's manufacturing difficulties, it is nevertheless a contribution to the reduction of manufacturing expense. What has been accomplished in this particular, however, is a finger-

EASTERN REFINERS SPRING MEETING

board pointing out the further possibilities of profit by similar means in other refining activities.

What I have in mind and the idea I am trying to emphasize to you would cover the entire field of refining. It is not a new idea of mine either, for two years ago one of your trustees, B. B. Stroud, made an effort along similar lines. Only last year another of your trustees, Commander G. C. Davison, made very valuable suggestions which contemplated the one hundred per cent. cooperation of every member of your Association. So far as I know, but little action was accorded his suggestions. The necessity of this undertaking is now self-evident, and I shall make the attempt to prove this by such reasonable suggestion as I hope will merit your most serious consideration.

One of our prominent engineers has said that "The average industrial executive is interested in and knows a lot more about C.O.D. than he does about CO_2." The inference is that greater importance is usually afforded the sales phase of a business, while the economics of manufacture are either misunderstanding or neglected.

Manufacturing production today in terms of C.O.D. may mean "Cash on Delivery" or "Credit on Demand." It has the potential menace also of "Confusion or Defeat." It should signify "Concentrate on Details."

The term CO_2 implies a suggestion of efficiency so that a means of profit may be afforded, not so much by a volume production and all the grief it entails, but rather by such scientific attention to manufacturing technique as will reduce the cost of the finished product unit.

I know of no industry that is forced to purchase its raw material in a competitive manner similar to the petroleum refiner in the eastern field. Usually in other industries a supply of crude materials is plentiful, and while the quality might command a slight premium, the manufacturer has numerous sources of supply. In this petroleum field the independent refiner, to a great extent, has been dependent upon one source of crude supply that has a reputation of being the finest in the world. He can go out into the open market and purchase fuel in a competitive manner. He can purchase all other supplies such as clays, equipment, labor, etc., in a similar way, but he has been forced into a unique situation of competing and out-bidding his neighbor for the material which he wants to process. After he has obtained this crude at a premium, and probably spent a dollar or more to refine it, he is confronted with a critical competitive sales situation in order to dispose of the product; but now instead of simply out-bidding a local neighbor for sales preferment, his competitive marketing problems become country-wide. If the supply of crude material was unlimited, he might be able to overcome the competitive purchase handicap. Competition of this character to assure volume production, automatically reduces the supply of available material, thus increasing the cost, and he penalizes himself accordingly. With a one hundred per cent cooperation of its members, don't you believe that the National Petroleum Association could at least alleviate such an uneconomic situation?

FEWER UNITS INDICATED

Industrial mass production today is affording some very curious and serious economic situations. On the one hand we find large industries maintaining research departments and investing heavy amounts of money to produce a volume of materials that will afford profit. At the same time, full use of this same department is made, to reduce the cost of manufacture by curtailing the consumption of supplies and labor essential to the product which is manufactured. This tends to show that industry is headed toward larger and fewer manufacturing units.

As an illustration and referring to our own industry specifically: We endeavor to reduce our cost of manufacture by increasing the efficiency of our boilers and stills and thus curtail fuel costs. This same thing applies to filtering costs in reducing the consumption of clay. We endeavor to increase the unit of production by large investment for new equipment, thus reducing labor costs. All of this procedure is correct and as it should be. But in doing this, we affect our suppliers' mass production schedule proportionally. These suppliers are also consumers of the products we manufacture, and they in turn through their research departments are endeavoring to curtail the products from which we obtain our profit. Thus on the one hand we try to reduce the other fellow's production outlet, while at the same time we endeavor to force him into taking our volume production. How long can such a situation exist? After all is said, we might find an analogy in the snake that tried to swallow his own tail. This is an economically unsound business situation that has a far-reaching effect, and is causing grave concern in the ranks of the economist. Do you suppose that an Association cooperative clearing-house could help this situation?

OLD TRADITIONS UPSET BY SCIENCE

In former years the scientific man was given scant industrial consideration. Now his influence and his synthesis is having a tremendous effect upon civilization. He can produce motor gases and lubricants from coal. He can reverse the operation and convert petroleum into coal. Let me quote that eminent authority Dr. Edwin E. Slosson. He says, "Does a given sample of butter come from a cow or a cocoanut? Does a given sample of sugar come from beet or cane? Does a given sample of alcohol come from grain or wine? Does a given sample of acetic acid come from forest or plantation? Does a given sample of musk come from seed of hibiscus or glands of deer? Perhaps neither, for perchance the butter and

EASTERN REFINERS SPRING MEETING

sugar, the alcohol and vinegar, the rubber and the perfume may all have come from coal. Nobody knows but the chemist who made it and maybe he won't tell. Anyhow it is 'Nobody's Business', if the chemist has done his work well enough so the product is correct. After a compound has come under the domain of the chemist it has renounced all allegiance to the kingdom of its natural origin." What of the cooperative possibilities to be had in finding out what this means, and how it may affect our business?

Some years ago the gasoline fractions of crude oil were not only a glut on the market, but also a menace to the refiner. Coincident with the development of the automobile, increasing demand for this product developed and the supply was inadequate to satisfy the need. The chemist stepped into the breach and by rearrangement of the molecular structure of the heavier hydro-carbon fractions, produced a synthetic gasoline which was equal to and in some respects better than the natural material.

As research continues and we learn more through the effort of the laboratory, a point may be reached where motor gas will again become more or less of a problem. And why? Because the scientist, the chemist and the engineer have learned that they can produce such distillate substitutes as will satisfactorily operate the motor car, from coal, from cornstalks and other abundant vegetation. Do you suppose that cooperative investigation of this fact would be of any value?

An engineer develops the idea that he can produce power cheaper and derive greater operating economics from crude oil or heavy fractions thereof than he can with either gasoline or coal. If you doubt this, let me tell you about the economies which are now obtained from a good Diesel engine. This machine will have a thermal efficiency of 35 per cent. The ordinary locomotive has an efficiency of about eight per cent. An ordinary steam plant with non-condensing reciprocating engines will have an efficiency of from 10 to 12 per cent. High-pressure compound expansion condensing engines have an efficiency of about 20 per cent. The most modern steam turbine plants using re-heat cycles may obtain 30 per cent.

DIESEL ENGINE NEXT

Rapid development of the Diesel type engine has heretofore not been possible because of mechanical limitations which prevented a minimum weight per given horse power. This difficulty has been overcome, and I am reliably informed that our own government is now building experimental Diesel type engines for the air-plane service. Diesel motored trucks are actually traveling our highways, and certain automotive engineers are conducting research experiments in the pleasure-car field with considerable success. L. A. Woolson of the Packard Motor Car Company, says in the February number of the S.A.E. Journal that the engine experimented with by his company weighs less than three pounds per horse power developed, is capable of withstanding cylinder pressures in excess of 1200 pounds per square inch and operates at compression ratios as high as 18 to one and at engine speeds from 1700 to 2000 r.p.m.

The greatest advantage claimed for this type of engine as compared with the gasoline engines now used universally for airplanes is its reliability. If one cylinder fails for any reason to function, the others continue, and the only effect is a reduction of power. For these reasons Mr. Woolson believes that the oil engine is so relaible that when such engines become commercially available in large sizes it will not be necessary to use more than one engine in large airplanes. The second most important advantage is that virtually no fire risk exists with the Diesel engine, and consequently the dangers to passengers and pilot in case of a crash are greatly diminished. A third great advantage is that the specific fuel consumption is about 20 per cent less than with the gasoline engine, and the fuel cost is reduced about 70 per cent.

It is a known fact that a major company now has under "Lock and Key" a Diesel type marvel of efficiency. Draw your own conclusions. Undoubtedly, gasoline will still be required for some years to operate the product of Henry's large enterprise at least, but do you think for one moment that his great organization or any other manufacturer of automotive equipment would hesitate to take advantage of a motive power that would afford increased and economic operating advantages? Who knows how soon it may be more advantageous to increase the yield of heavier distillates?

A conference on the possibilities of oil and gas power will be held as the second national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers at Pennsylvania State College in conjunction with the third annual oil and power conference of the college from June 24 to 27. One of the features will be an exhibition of oil engines, parts and accessories. Over twenty companies participated in the exhibit last year, the first of its kind ever held in the United States, the total attendance being over 500. Practically every representative manufacturer of Diesel engines is expected to attend the conference. Another feature will be a discussion of uniform fuel-oil specification standards. Do you attach any importance to this announcement, or would it pay you to be represented at this meeting in a cooperative way so as to receive a full report of what it is all about?

May I present another view of the picture and the brief reference which I made to the hydrogenation of coal in my last address to you at Atlantic City. It is common report that a major refining company is now conducting experiments along this line at Baton Rouge, La. Maybe they are looking ahead a good many years, but the very fact that an experi-

EASTERN REFINERS SPRING MEETING

mental plant is in operation in this country affords the evidence that such an industry has possibilities. If you think that the probability of producing lubricants and motor gases by this means is remote, let me tell you that at the 1928 Coal Conference in Pittsburgh it was reported that 104 gallons of crude oil were obtained from a ton of coal. From this, forty-five gallons of good gasoline were obtained by distillation, also fifty-five gallons of oil and four gallons of tar. The oil in turn yielded twenty gallons of spindle oil, thirty gallons of high grade motor oil and five gallons of cylinder oil and grease. The gasoline did not knock when used, probably due to the presence in it of considerable quantities of unsaturated compounds, more than in gasoline made by straight distillation of petroleum.

Last year at the Leuna Chemical Plant in Germany a yield of 70,000 tons of synthetic gasoline was produced by the hydrogenation of soft coal. This is equivalent to over 400,000 barrels. By the end of 1929 a production of 250,000 tons is anticipated. This is equivalent to over 1,400,000 barrels of synthetic motor gas. The process used in this and other synthetic productions are combinations of catalytic methods developed by Dr. Friedrich Bergius, the German chemist whose patents were acquired last year by the German Dye Trust. The American rights to this process are owned by Standard of New Jersey.

The argument is advanced that so long as our natural sources of crude petroleum remain abundant, the hydrogenation of coal will not be an active competitor. I am afraid, however, that such self-assurance tends to blind us to the potential possibilities of this process.

ICE FROM HEAT

The coke or char residuum which this process produces, affords a higher combustion reactivity than any of our other available solid fuels. This in turn affords the opportunity to maintain such high combustion rates in boiler operation as will produce maximum operating efficiencies, thereby reducing the cost to manufacture steam.

There is still another interesting possibility in this process. You have no doubt heard of Dry Ice or CO_2 snow. Do you know the origin of the carbon dioxide from which this refrigerant is produced? This chemical compound can be commercially manufactured from the waste flue gases produced in a boiler furnace. It so happens that coke usually contains less sulphur and lends itself more readily to the combustion control essential for high CO_2 condition of the flue gases. These gases are scrubbed and then absorbed in caustic solutions. The solutions are in turn heated by the hot boiler flue gases and the carbon dioxide gas driven off and stored in a gasometer to be later condensed by compression. You may consider this a "brain storm", but these things are being done commercially, and I assume profitably today. Think of the possibility of producing motor gas and lubricant, steam, electricity, heat and refrigeration, all from one and the same material: coal! Do you think there would be any economic possibilities in cooperatively learning more about this, if you can?

The illustrations may seem to be a stretch of the imagination, but when you consider the many recent upsets of old ideas and theories and the marvelous economic changes in our civilization—to say nothing about our own industry—that have occurred within the past five years, largely through the chemists' efforts, my guess as to the probable situation five years hence may not be so visionary after all.

You have already cooperated along some lines through the medium of the Association. Notwithstanding that this has not always been one hundred per cent, the return in the dollar saved is an established fact and can be proven in every instance. In the face of such concrete evidence, can you afford to withhold your support from a still more extensive effort?

It has been proven by eminent industrial engineers that the small industry can be, is today, and will be an active competitor of the large corporation for the obvious reason of lower manufacturing expense. I have in my office a scrapbook full of such statistics, but as my allotted time is short, I can only refer by way of illustration, to one very interesting article that has recently been published in the magazine "Mechanical Engineering," the official organ of the A.S.M.E. This paper was based on a survey of labor costs found in a number of industries. You all know that 1000 watts of electricity are expressed as a K.W.H. These investigators developed what they term a K.M.H. for their purpose. This kilo man-hour, or the product of 1000 man-power hours was applied as a labor cost yardstick to some sixty-six industrial surveys, seven of which were in the petroleum industry. Their findings in these seven plants showed that the average production per K.M.H. was 1610 barrels of petroleum products, and the value of these products was $7,570.00 per K.M.H., or $4.57 per barrel. This so interested me one evening recently, that I dug into my files of the refineries in which I am interested and worked until the "Wee Sma' Hours" to find out how some of our representative plants rated on this basis. Much to my surprise, I found that our average labor consumed for an equivalent output only amounted to about .65 K.M.H., while the value of the products was approximately $8,855.00, or about $5.50 per barrel.

SOME PROBABLE ADVANTAGES OF CO-OPERATION

If all of the old equipment, the new equipment contracted for, or the contemplated extensions for 1929 in our particular field is operated at maximum capacity, we know that there will not be sufficient crude to supply our requirements. Now! do you think that any particular plant or individual will be

CAUSTIC

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To meet your requirements

THE diversified consuming channels through which Caustic Soda travels make the specific needs of individual consumers differ widely. The Hooker Electrochemical Company recognizes this condition and employs its sales and technical staff to study the individual needs of each consumer in order to furnish material which shall meet these particular demands.

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Sulphur Monochloride
Sulphur Dichloride
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Fused or Solid Caustic Soda	*in Steel Drums*
Liquid Caustic Soda	*in Tank Cars*
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so self-sacrificing as to voluntarily step out of the picture? There is no evidence to warrant such a belief. Everyone concerned, hopefully anticipates some readjustment and is only marking time until this occurs. We may then anticipate full speed ahead, and the resulting competitive conditions again, if there is no restrictive influence to intervene. Cooperative effort along this line presents many economic possibilities.

In my effort to reduce your coal bills, I have found it necessary to give some consideration to your manufacturing costs in order to determine the percentage relationship of fuel costs thereto. It appears that the total costs run from $0.80 to $1.40 per barrel based on crude. This wide variation probably occurs mainly because of the dissimilarity in products run, fixed charges, etc. At the same time, and strange as it may seem, the lower costs usually occur in plants having the older type of shell stills finishing all products and H.R.T. boilers. In these plants some expenditure has been made to improve the efficiency of the equipment, but at the same time none of them neglect a single opportunity to see that this equipment affords economy plus. In other words, they seem to believe in an investment for brains as well as equipment.

Since the cooperative combustion attempt has been undertaken, the average cost for fuel per barrel of crude run has been reduced approximately 15 cents in the plants operating under our control.

I am convinced that this cash reduction can be considerably increased under normal operating conditions of throughput capacity, but in order to do so it is absolutely necessary that more consideration be given the recommendations that are made from time to time as the plant is visited, and also that your cooperative activities be continued, and enforced.

One of the greatest contributions to high fuel cost is the conduct of hand firing. This important matter seems to be "Nobody's Business" most of the time, but let your engineer stick his nose in the boiler room and immediately everybody is right on his toes. Why isn't this performance a continuous one, and who checks these matters?

As an illustration! Two refineries operating the same type of boilers and stokers were purchasing a high-grade coal at a premium price. It was thought advisable to purchase a cheaper grade. When a report on this cheaper coal was requested, the firemen in one plant reported fine! The men in the other plant reported that it wasn't worth a damn. Draw your own conclusions.

Another story of the opposite sort which shows a one hundred per cent cooperation between the management and the boiler operators, is emphasized by the twelve sets of charts I hand you. That they are genuine and true will be found in the fact that they are exhibited by permission of Harry A. Logan, manager of the United Refining Company. These charts have been taken from the files at random, which you may note by the dates. The boilers are 200 horse power, H.R. T. type and are hand fired.

You will observe that the top chart is a steam pressure curve! The next one the water temperature and the last one the load curve. Note that the two lower charts show a wide variation in temperatures and refinery demand, yet in spite of this, the pressure curve remains at a constant value. Note also the regularity and short intervals of firing indicated by the small peaks and valleys on the top chart. Incidentally, I may mention that these boilers never operate at less than one hundred per cent of rating. On the other hand, a 120 to 150 per cent load is generally carried, as the flow charts will show.

It is only fair to say in passing that we have other plants who maintain a high standard of efficiency. Also, and where this is the case, you will always find a proper regard for correct engineering methods. In all instances there is still much to be desired, but the attainment of what we believe to be possible must await the factors of time, opportunity, cash and co-operation.

This Association represents a number of relatively small units in the refining field that for years have conducted their business along traditional rather than scientific lines. We have been handicaped and are now paying the penalty for the money that has been invested in sporadic inventions and "Frankenstein Monsters" which the high-pressure salesman assured us, "Would lick our competitors to a 'frazzle' ". Inasmuch as he also told the other fellow the same story, we now find ourselves all in the same boat.

In conclusion I want to quote part of a recent report of the Babson Statistical Organization. They say, "We believe that business is entering an era of the most rapid and revolutionary changes in the chemistry and physics of manufacturing. To those who are quickest in taking advantage of such discoveries they present unlimited opportunities, but the manufacturer, merchant or investor who is asleep to the changes will be hurt.

"The time has passed when advertising alone will get sales. The two best salesmen today are a "better product" and a "cheaper way of making it." Research opens the way to both. Furthermore, since the most deadly competition is not between concerns, but between industries, we urge clients to combine their energies with others in the same line of business. This saves duplication of efforts, leads to maximum results and keeps you best informed about all important developments. Make use of the help which the United States Bureau of Standards at Washington stands ready to give you, and also that of other technical organizations of high standing. Cease worrying about gaining the temporary advantage of exclusive patents or products and combine your resources in the way that will do most to permanently help your industry."

EASTERN REFINERS SPRING MEETING

Pricing of Inventory

By H. W. RALPH

WHEN I was asked to prepare a paper on this subject, I must admit that my first thought was that this was an opportunity to pick out some methods of pricing that I have seen used—including that advocated by many prominent authorities and adopted at a conference of the Federal Trade Commission, which might be called Proportional Product Value Method—and shoot them full of holes, and then trot out my own pet idea, point out is advantages, and ask you to help me admire its good features.

You would of course have taken the time I used to point out these good characteristics to get together your ammunition and have been ready to shoot holes in my pet. All together it is possible that we would have had a very interesting or argumentative discussion.

Second thought, however, convinced me that this is not the most constructive method of discussing the subject. It is not because of any feeling that my own pet notion would be so badly mutilated that it would not survive; but because of a knowledge that the scheme of pricing which I advocate could not be used to advantage by organizations unless it fitted into their general accounting system.

Let me start by making the statement that any method that you are using at this particular time to price your inventory is probably the best, for otherwise you would not continue to use it; and socondly, that I would be one of the last persons to have you stop pricing your inventories in that manner.

If you want to make any change, instead of substituting another method, let it be an addition to your present method.

Next, let me ask a question the answer to which may help us in deciding what method of pricing will give us the most satisfactory results. That question is "Why is it necessary to price inventories at all?"

To some people a profession seems an end in itself. Law, medicine, dentistry, and each kind of engineering are in themselves a justification of existence. In exactly the same way accounting is considered a profession. In reality a profession is justified by the service it performs. For myself, since I happen to be a civil engineer, and to some degree an accountant, it is merely a background which enables me to render a better service.

PURPOSE OF PRICING

From your standpoint, gentlemen, accounting is and should be a service. Your problem, as business operators in the petroleum industry, is to earn profits. Accounting is that activity which in its most elementary form is a systematic record of ownership. In its most useful aspect it will present reliable information about your business in the form which will enable you to make sound decisions with the minimum of effort. Until you develop that attitude of mind toward accounting it will continue to remain in the same category with taxes and insurance—a necessary evil.

It may be that in your organization the determination of what prices inventories shall carry is not considered to be an accounting function—it is a responsibility of the chief management executive. It is, of course, a fact that the accounting work for any period can not be completed until some basis for pricing inventories has been decided upon.

The determination of the value of inventories affects two important accounting documents—the balance sheet and the profit and loss statement. It is from a consideration of the purposes to which these documents are put that we develop an answer to our question "why do we price inventories at all?" These statements arise from our need for knowing more facts about our business; and so we find that the reason for pricing inventories is to add to our store of useful facts about our business.

We like to consider the balance sheet and the profit and loss statement of an organization as documents of marked accuracy when, as a matter of fact, they are not. They can be no more accurate than the elements that enter into them. Some of the elements are definite, but many are indeterminate. Some of these indeterminate items are relatively important—such as the item of depletion, or of depreciation; but there is not apt to be a sudden change in our ideas of the amount of these items sufficient to seriously affect the balance sheet and the current profit and loss statement. Our ideas of inventory values, however, are in quite a different category. The prices put on the inventory have a very direct bearing on the balance sheet; and on the earnings of the preceding and succeeding periods.

In pricing an inventory it is possible to do one of three things—to set up a precise value, to set up an under-statement of value, or to set up an over-statement of value.

Since the purpose of an organization is to earn profits currently, and to be in a position to continue to earn profits, it is apparent that, in the absence of

EASTERN REFINERS SPRING MEETING

ulterior motives, no person will deliberately overstate assets if they feel that operations in the immediate future will probably expose such overstatement. They will have no hesitation, however, in understating the value of an inventory if they can do so unobserved and thus build up a protection against future contingencies or reverses.

COST OR MARKET

Another influence which works in the same direction is the ruling imposed by the government in relation to the pricing of inventories for income tax purposes. They permit pricing at "cost" or "cost or market, whichever lower." From the standpoint of accurate information both as to the present condition of a company and the results of its operations over a period of time just completed, our ideas would be improved if market prices were always brought into the picture. The increase or decrease in value which may occur in the future because of market fluctuations is an element of sufficient importance to justify its isolation and separate study.

The real reason why the government has promulgated this rule is twofold. First, it has always been the practice for conservative accountants and conservative executives to use this basis; since they thereby protect themselves as far as is reasonably possible against losses which in the light of future sales realizations might be considered as due to the overvaluation of inventories. Secondly, on this basis the government is protected to a marked degree against amended earning statements and refunds of income tax payments.

From our standpoint of having accounting of the maximum service to management; and our corollary that pricing of inventories shall give us as much information as is useful—what methods shall we use in pricing inventories?

Let us assume, first, that our organization is committed to the policy of "cost or market, whichever lower." What then is cost, and what is market?

We may define market price as the price which on any day can be realized for a particular commodity at the particular point where it happens to be located. In order to determine this price we must have definite information as to prices quoted for particular commodities currently; and form our decision as to the market price on the basis of that knowledge.

By "cost" we mean the amount of money expended for raw materials, supplies, labor and indirect charges which enter into the production of the commodity in which we are interested. If no precise allocation is made or can be made of all elements of expenditure necessary to obtain a particular commodity, it is clear that actual "cost" is impossible to obtain, and that what we mean by "cost" must be as close an approximation as we can develop.

First, we will consider those commodities which are on hand in the original condition in which they were purchased. The cost of these commodities will be the amount of money which was paid for them plus the cost of unloading, handling and storing. The cost of storing will be dependent on the facilities necessary for such storage and may properly include such items as taxes, insurance, depreciation and even interest on the investment in storage facilities. If the materials purchased are in excess of what might be called normal manufacturing or selling requirements; and are kept for a long time, interest on the money paid for the commodity can properly be included as an element of cost.

PRICING CRUDE OIL

The preceding paragraph has special reference to crude oil and what might, from the standpoint of the refiner, be termed purchased stock. An organization might purchase several kinds of crude and might accumulate a reserve of crude at a time when prices were considered right. As long as the different kinds of crude were kept physically separate the cost should be kept separate. How then shall we determine the cost of the inventory on hand at the close of each month; and the cost of the crude oil consumed?

There are three methods in general use—that of running average cost, in which the opening inventory is combined with the current receipts and the total amount in dollars divided by the total quantity of crude; that of lot pricing, in which the purchase of a particular block maintains a separate identity until the proper time has arrived, in the mind of the responsible executive, for the utilization of that particular lot; that of pricing the inventory at the price paid for the latest purchases of an equivalent quantity. We also find methods which are a combination of two or more of these basic ideas.

It will be found that any one of these methods has disadvantages which might result in the validity of the accounting reports of a company being discredited. In other industries, particularly those in which futures are dealt in, it has been found necessary for the accounting department to develop costs by all three of these methods; carry the books forward on the basis which involved a minimum of clerical effort and minimized the effect of market fluctuation; and then maintain an inventory adjustment account which would currently reflect the best judgment of the responsible officers of the company as to the current position of the company and the probable future position.

The general rule which I would recommend to anyone confronted with these problems is that so far as is possible consistent with economy of clerical effort that the accounting follow the physical facts. That when the regular basis of pricing is inconsistent with the line of thought of the responsible executives a separate and distinct cost calculation be developed which agrees with the theory of such executives and that the executives be asked to make a decision as to the values which are to be used in

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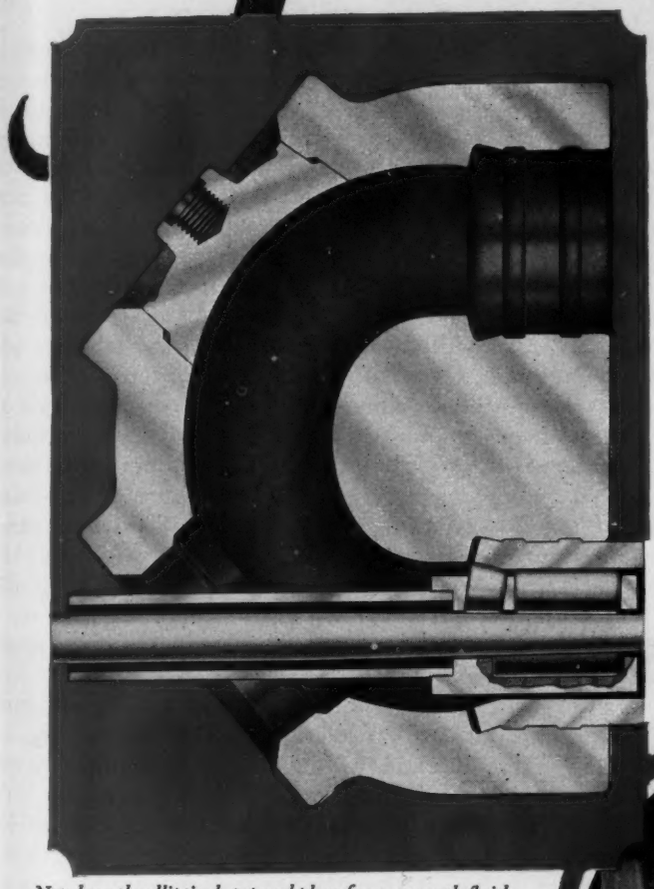

Note how the elliptical, tapered plugs form a smooth fluid channel, and allow easy cleaning of the crossover passage

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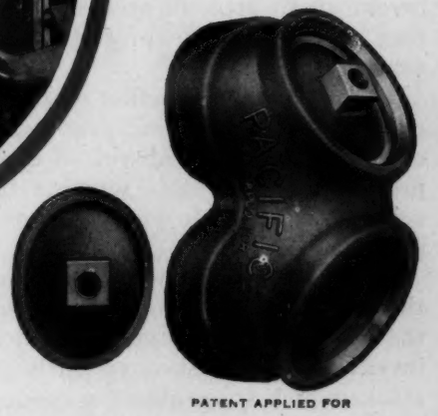

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the books. Such values should be put into effect in whatever manner requires the least effort—usually by allowing the regular entries to stand and making appropriate entries in an inventory adjustment account. Adjustments of this kind should be applied to important items in the inventory only, since items which are unimportant from a money standpoint—whether by reason of small quantities or low value will not affect ultimate results sufficiently to warrant any extra statistical or accounting work.

If, at the end of a fiscal year there is a considerable balance in this inventory adjustment account, either debit or credit, it will be found advantageous to extinguish such balance by repricing all inventories. This will simplify the making of subsequent analyses of the results of future operations.

FOR AN INTEGRATED COMPANY

Before leaving the question of how to price a crude oil inventory let us consider the problem of an integrated organization—one which is engaged in production, refining and retail marketing. If their practice is to use cost throughout—the crude will be carried at what they calculate is the cost of production. There is no question that this cost should include such charges as are necessary to build up a reserve for depletion and a reserve for depreciation, interest on capital employed in production, etc.

If, on the other hand, it is their practice to transfer crude to the refinery at a fixed price or the current market price there may be an element of profit in the crude inventory valuation which requires consideration. It will be found very easy, from the standpoint ot clerical effort, to make a calculation showing the proportion of profit of the production section represented by the inventory of crude oil and then make a journal entry affecting the profit and loss account and an account entitled "crude oil inventory adjustment account" which will eliminate that aversion of the professional accountant "unearned profit."

The question of whether costs shall be determined on the basis of running average, lot pricing or latest quantities received will, of course, enter into the problem just the same whether the crude oil is received from outside sources or produced by the organization.

And now we come to the problem which is the particular problem of the majority of the members of the National Petroleum Association. How shall the inventories of finished products and "in process" stocks which are made from crude oil be priced each month and at the end of the fiscal year.

Those of you who are executive and accounting officers of experience; and have already faced an irate board of directors who want to know "How is it that a few months ago we showed a fine profit; and now, with the end of the year in sight, we have nothing to show for our efforts but a big loss" have an immediate answer; "It isn't so important that we know just how it is done, but be sure that is low enough so that we do not turn a reported profit into a sickening loss in the next few months."

FINISHED PRODUCTS

There is one very simple method to accomplish this result; use the lowest price you have had in the past five or ten years for each of the products in pricing the inventory. By doing so you will never develop from your records reliable information as to the success of your activities for current periods, but you are unlikely to have to reverse previous favorable reports. Some years ago, particularly before the war, when the methods of the various refineries had not changed much since the time of erection of the plant, this method was reputed to have another advantage. It permitted direct comparison of the values of monthly production with preceding periods to be used as an indicator of efficiency. Such a comparison is meaningless if the refinery operations have been changed or when dissimilar value of products are used. At its best the method will not bear careful scrutiny. In my opinion this method serves only one purpose successfully; and that is to keep the statement of earnings on the safe side. In these days it will be demonstrably well below what we know is our cost.

Let us consider another method which will give the same kind of protection, but in a less degree. This is the method which bears the stamp of government approval and may be considered to give cost. The basic idea is to calculate the cost of refined products on an apportionment according to the relative value of the net realization of products at the refinery siding. If the total value of current production is less than the sum of expenditures for raw materials, supplies, labor and indirect charges market prices are used. If in excess, then the percentage of margin between these two amounts is used to make a percentage reduction in the value of each product. By this method, too, you practically eliminate the bogey of unearned profit; and your profits will develop during the months in which you ship the products of largest value. The usefulness of this method of pricing is marked from the standpoint of a conservative accountant. Since it reflects in inventory prices the latest realizations of products the likelihood of serious changes in relative values of products is very slight; and so the arbitrary adjustments sometimes necessary to adjust prices to the market are likely to be insignificant. Since it sets up a picture that rarely has to be disturbed subsequently it has claims to still another valuable characteristic. Its use results in the development for all organizations in the industry of a similar financial cross section, regardless of the location or the type of operation. Further it will rarely happen that at the close of a fiscal year inventory prices will require adjustment if inventories are priced in this manner as a part of the usual routine.

My criticism of the method is easily stated. When

If some stockholders knew what some refinery operating officials know, there would be only one cracking process used — the one which operates on fuel oil and produces no fuel oil for sale

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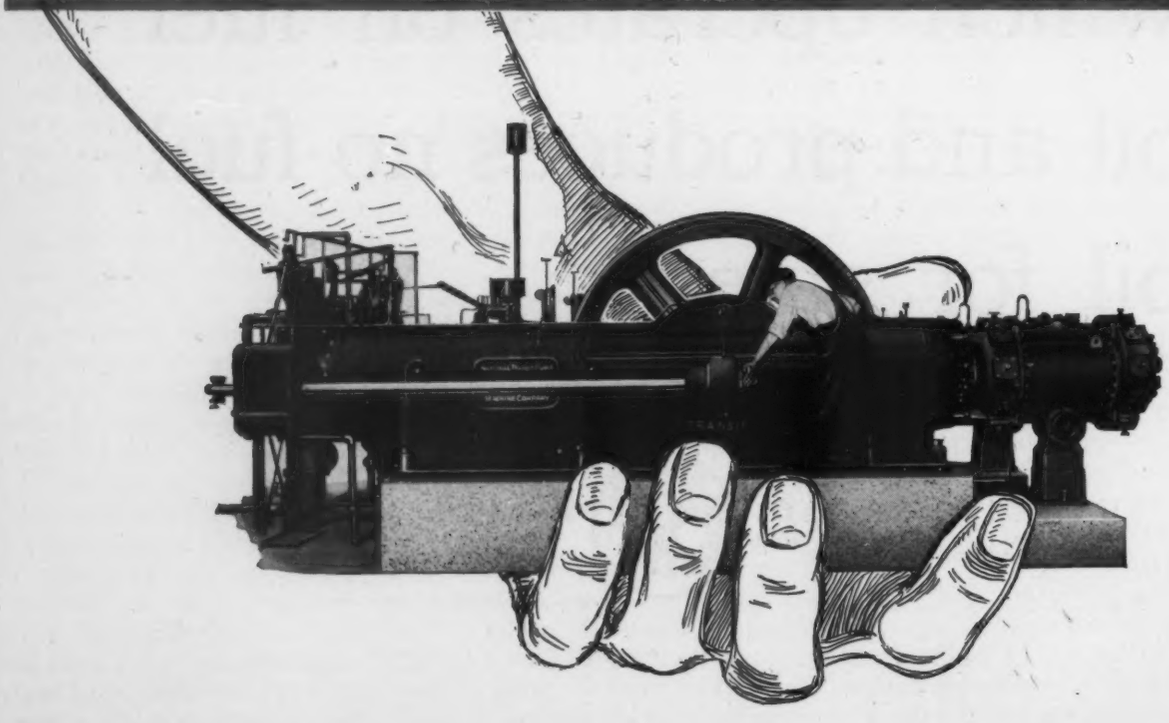

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you know the actual margin that results from your operations you have a fact of sufficient value to reflect in your accounting. When you make a number of arithmetical calculations which result in a breakdown of this significant figure into meaningless parts and then incorporate these into your accounting—you have performed some needless work which nets you less than nothing.

DIFFICULTIES

The attempt to apply this principle to the individual inventories of an organization which maintains a large number of bulk stations and service stations so that an individual monthly profit and loss statement can be made for each unit would require the performance of a stupendous amount of work at the end of the month. Perhaps this constitutes a real reason why the oil industry has so many organizations, both large and small, which profess they find it impracticable, or too expensive, to find out which sales units operate at a profit or a loss.

In order to explain the method which seems to me to have the main advantages and the least disadvantages it is necessary to get back to the theme that was discussed in the early part of this paper—the real purpose of accounting—that of performing a service to management.

If management is to be successful in all of its activities—it must be successful, that is, earn profits in each of its activities—and that means it must earn profits in production, in refining, in selling and in its trading. Success is measured in terms of dollars earned.

It will be impossible to develop the amount of earnings unless we set up some method of pricing so that when commodities pass from one jurisdiction into another they are given a price which currently reflects the value at the time such change of ownership takes place.

Further, the responsibility of management covers the satisfactory coordination of all the elements of a business enterprise; and involves in particular the manipulation of purchases and sales so that without interruption to production, manufacturing or selling the results of unfavorable price movements will be of least effect and full advantage will be taken of favorable price movements. Whether the result of these operations is a profit or a loss, it is important that the profit or loss which accrues to an organization from the fluctuation of prices for raw materials and finished products be isolated so that the results arising from operation of the production department or the refining department or the selling department may be judged on their own merits. Unless this is done it is very difficult to make comparisons of monthly results and build up standards of performance for each activity.

RESERVE STOCKS

We will assume that at the time that commodities pass from one of these departments to the other that equitable values are established for these commodities; and on the basis of these transfer values there is devoleped a profit and loss statement for each of these departments each month.

In order to do this we lay down the general principle that the accumulation of reserve stocks of raw materials and of finished products is a responsibility of the trading department, or of management itself; and that such reserve stocks, whether of raw materials or of finished products, whether located in the field, at the refinery or at important distributing points, are the property of the trading department.

The production department is credited at current market prices for the crude oil that passes out of its ownership; the refinery is charged at current market price for the crude that it consumes, as well as the purchased stocks that it receives; the refinery is credited at current market price for the finished commodities produced; and the sales department is charged at the current market price for commodities at the time they are shipped for them or to them.

The profit and loss statements of the production department, the refinery and the sales department are valuable indicators of the success of these departments in performing their part of the general function—that of earning profits.

In pricing the stocks that are in the possession and ownership of the production department, which are to be relatively small, we can use the current market price, reduced by the estimated profit of so much production and reduced by an estimate of the expense still required to enable possession to be passed to others. For all stocks in the posession and ownership of the refinery we can use the purchase price or the transfer price.

For "in process" stocks at the refinery it is suggested that an estimate be made of the ultimate production of finished stocks that can be expected when the processing has been completed; and that on the basis of this estimate a percentage calculation be made of the value of each "in process" stock; that this value be reduced by an estimate of the expense required to make the finished products; and that this adjusted value per gallon be used to establish the value of "in process" stocks. For all stocks in the possession and ownership of the sales department it is suggested that the price of transfer be used—combining with the previous inventory to obtain the running average.

AGAINST FALLING PRICES

Again I would like to point out the fact that neither the production department, the refinery nor the sales department are permitted to have in possession and ownership reserve stocks which have been accumulated as the result of company policy to accumulate reserves at times of low prices. Their ownership will be limited to the quantities which are considered sufficient for continued satisfactory operation.

With this basis of pricing in effect we need to

EASTERN REFINERS SPRING MEETING

have in mind a protection against "unearned profit" or of falling prices. With the prices that have prevailed since the close of the accounting period as a gauge of values, for the decision need not be made until practically all of the accounting work has been finished, it becomes a very simple matter after making a comparison of the values developed by the running average method to decide whether an adjustment is needed. If needed, a journal entry affecting an inventory adjustment account and the profit and loss account—and all of the operating reports and statistics will remain unchanged barometers of the degree of success in the various activities.

This scheme of pricing appeals to me as the most valuable—since it presents the maximum of information with the minimum of effort. Under the policy in use by nearly all organizations—"cost or market, whichever lower" at the close of the fiscal year, this method is already in use at the most critical and difficult time—when commodity prices are falling. All other systems fail if values drop too suddenly.

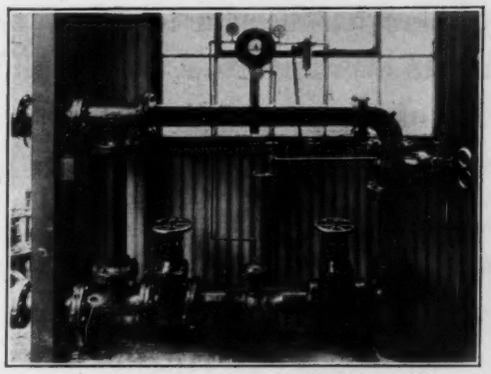
I do not urge you to discard your own method of pricing; but let me urge you to develop additional helpful information by pricing at market also. If the steps outlined above are followed out the inventories that are carried by the trading department will be those that show the effect of price changes; and the inventories of other departments will be carried on a basis which closely reflects recent market prices but are primarily useful in that they enable a profit and loss statement to be built up for the production activities, the refining activities and the selling activities which reflects the result of performance complicated to only a slight degree by the vagaries of market prices.

If you have a large organization I recommend that accounting records be installed which will automatically reflect the result of the separate activities of production, refining, selling and trading. If your organization is small it is not essential that you make a radical change. Rearrange your statements of inventory and production so that it will require only a few simple calculations to determine the current result of these four activities.

After this has been done for several months I predict you will find yourselves very much more definitely concerned with the results to be expected from each activity; and in the process of developing standards of performance for each. Other steps will follow naturally as you continue your effort to find significant facts which will guide you in making decisions that lead to efficiency, economy and profit; and these will all be due to one small action on your part—to so price inventories that the information developed thereby will be of real benefit.

Tycos Steam Boiler Gas Fuel Regulator

(Pilot Operated)



Tycos Steam Boiler Gas Fuel Governor (Pilot Operated), maintaining constant steam header pressures in natural gasoline power plant by regulating the gas supply to the battery of boilers.

This installation insures constant steam pressures under varying load conditions by properly regulating the gas fuel supply to the burners. Full steam pressures are maintained under extreme operating conditions, thus insuring a high efficiency and consistent operation of the boiler plant.

An increase in steam consumption or tendency toward a drop in boiler pressure immediately re-acts through the regulator to further open the diaphragm valve in the gas supply line, to such a position as is necessary to maintain constant steam pressures under this new condition; a decrease in steam consumption, or tendency toward an increase in boiler pressure likewise immediately re-acts to throttle down on the diaphragm valve to meet this more limited fuel requirement. More gas is admitted or the supply is throttled down as the load increases or decreases.

With the Tycos installation shown above the operator has complete information before him as to the pressures he is controlling, and the exact action of the control valve.

Write today for further information on this installation.

Taylor Instrument Companies

Rochester, N. Y., U. S. A.

Canadian Plant: Tycos Bldg., Toronto.

Manufacturing Distributors in Great Britain: Short & Mason, Ltd., London

Tycos
Temperature Instruments
INDICATING-RECORDING-CONTROLLING

COOPER AND BESSEMER

UNITED FOR SINGLE PURPOSE

The C. & G. Cooper Company and the Bessemer Gas Engine Company have combined for one, single, primary reason: to offer the Oil and Gas Industry greater service and greater engine values than ever before obtainable at any price.

ELIMINATES DUPLICATION OF EXPENSE

Recently there has been a tendency for the Cooper and Bessemer lines to overlap. Now, by consolidation of companies, this duplication of expense is eliminated. Power users are bound to profit from the resulting economies in manufacturing, engineering and sales costs. Rapid strides will be made in the way of research, engineering, and field service.

COMPANIES MERGED AT HEIGHT

The merger found the Cooper company and the Bessemer company at the high point of their individual business success. Bessemer had just completed its largest month's production in history. Cooper had just secured the largest single order ever placed for gas engines—18,000 horse power.

127 YEARS' COMBINED EXPERIENCE

With Cooper's 96 years of engine-building, and Bessemer's 31 years, The Cooper-Bessemer Corporation inherits a combined experience of 127 years. Cooper has long been the leader in the 4-cycle engine field, especially for service in the natural gas and oil industry. Bessemer has held an equally strong position in the pumping and drilling engine and the 2-cycle compressor

Unite for Greater Service

engine fields—also in the marine and stationary Diesel engine fields.

OWNERSHIP REMAINS THE SAME

The individuals responsible for Cooper and Bessemer success are still the largest shareholders and retain active control. The management of the two companies has been consolidated. Engineering and manufacturing efforts have been unified and standardized. Sales offices are under one man's direct control, but the Cooper and Bessemer sales personnel will be retained.

LINES COMBINED AND STANDARDIZED

Cooper, Bessemer, and Hope engines will be manufactured in standard sizes up to 1500 B. H. P. to meet every condition of service. The combined lines will include small drilling and pumping engines, 2 or 4-cycle compressor engines, vertical or horizontal engines for general power purposes, Diesel oil engines for oil pipe line and electric power generation.

FRIENDLY SERVICE WILL CONTINUE

No matter when you buy your Cooper, Bessemer or Hope—you will get the most advanced, the most reliable, the most economical unit of its type. The same personal contacts, the same friendly service and frankness that built our business will continue. That is our pledge.

THE COOPER-BESSEMER CORPORATION

FORMERLY

The C. & G. Cooper Company and The Bessemer Gas Engine Company

MT. VERNON, OHIO PLANTS GROVE CITY, PENNA.

EASTERN REFINERS SPRING MEETING

"Peaks and Valleys"

By N. H. SANGER
Pure Oil Company

COMMERCE, according to the oft quoted Mr. Webster, is the exchange of goods or property. Twentieth century commerce implies, usually, the exchange of goods for money. This modern commerce has evolved into a tremendously competitive thing, a perpetual struggle of business minds of one group against those of another faction, usually for the favor and patronage of that indispensable backbone of commerce, the consuming public.

And what line of endeavor in the whole category of commercial pursuits is more competitive than the business of petroleum? From the first whisper of a prospective play in wildcat territory to the time of putting gas into the customer's tank, it is not a matter of man against man, corporation against corporation, and sometimes nation against nation?

With such commercial stress, executives have have found it more and more necessary to keep up to the minute on vital facts and figures of not only their own affairs, but also those of their competitors, and commercial conditions in general.

Out of this necessity there has been born, or is being born, a new science. We know little of it, for it is not used or appreciated to one-tenth the extent it should be, and will be. Once a young man was asked if he played a good game of bridge. His reply was, "Yes, I learned last evening." Such is the status of commercial graphics, the science of pictorial information.

Some will say it is not new, that it is merely "statistics", but I think it deserves a more interesting name. At least if it is statistics, it is statistics with a lot of "whoopee".

Let us assume the boss wants to review the gasoline situation in the United States from 1918 to date. I could hand him three large sheets of solid figures consisting of Bureau of Mines data on gasoline.

PICTURES TELL THE STORY

If he studied these figures tediously for several hours he perhaps would be able to ferret out scattered gasoline relationships, but he most certainly would lose his pleasant disposition. Having a particular aversion to bosses in unpleasant mood, I set about to save his disposition and a few hours of his time, so draw a picture for him.

He sits back comfortably scrutinizing the graph, while I begin to supply the talk for our talking movie.

"In 1918," I begin, "our gasoline demand averaged about 250 million gallons a month. Ten years later, in 1928, it did better than 1,300 million a month, an increase of more than five times."

"A phenomenal growth," suggests the boss.

"Yes, but a regular and easily predictable growth," I point out. "Let's trace the history of gasoline a bit. Back in 1918 gasoline prices were steady due to voluntary stabilization through the War Board.

"Then the war ended but as most gasoline demand was domestic there was no over-supply. Prices remained firm.

"In 1920 there was a sharp price increase and all through the summer refiners had a fifteen cent margin over and above the cost of crude."

"Those were the days," sighs the boss.

"But that changed," I resumed. "In the last quar-

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TRADE MARK REG. U.S. PAT. OFF.
The Dough-Like All Metallic Packing
The Worthington Pump and Machinery Company have adopted our No. 3 Packing on Oil and its Products.
WE DO NOT TALK A GOOD PACKING
BUT WE DO PRODUCE IT.
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154 NASSAU ST NEW YORK CITY
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EASTERN REFINERS SPRING MEETING

ter of the year stimulated operations at home and in Mexico ran headlong into the gathering storm of general business depression and there was the inevitable decline. U. S. Motor, Group 3, dropped from 23 to 13 cents and Mid-Continent crude from $3.50 a barrel to $2.00. Things began to look better toward the end of the year, however.

"In 1922 there was steady improvement up to mid-year but stocks got top-heavy and the gain was more than lost.

DOWN AGAIN

"In 1923 Eastern refiners prepared for a big season. Simultaneously California found great new pools of crude and dumped great quantities of crude and gasoline on the East Coast. The result was 6½c U. S. Motor, Group 3.

"1924 was a distress gasoline year, and 1925 started out the same way, getting some relief in mid-year, but California gasoline again flooded out the improvement.

"Gasoline stocks were top-heavy at the start of 1926 but improved gradually so that U. S. Motor hugged the 10 cents mark all year.

"1927 we shall speak of in a whisper. Stocks were built to preposterous heights by refiners during the winter and they suffered in consequence, the price being pegged at six cents the latter part of the year.

"Due to refining restraint, particularly in the Mid-Continent, excess stocks were not built up during the winter of 1927-1928 and 1928 was a comparatively good gasoline year."

"What of 1929?" interposed the boss.

"Not as favorable as last year," I answered. "Too much production increase during the year. I look for a U. S. Motor price line in between the 1927 and 1928 line, but with more the trend of the 1927 line. However, even now the refiners can help immeasurably by showing discretion in still runs."

"It seems," ventured the boss, "that the refiner has had a constant struggle since 1923 to realize a good price for his gasoline."

"Exactly. The fact has been disregarded that our gasoline demand is of quite definite magnitude. The futility of this disregard was demonstrated emphatically in 1927. The wisdom of normal stocks and production was proved in 1928."

"How about California?" the boss asked.

"California," I replied, "showed a marked increase in gasoline production during 1928. The average was 234 million gallons monthly while the combined states of Washington, Oregon, California, Nevada and Arizona used only 128 million gallons a month, the excess production available for water shipment being 106 million gallons each month. In 1929 these five states will use about 140 million gallons a month. California can average 280 millions a month

Rectifying Equipment

Adapted to your Needs

ERECO Rectifying Equipment is like a tailor-made suit—it is exactly fitted to your needs. When designing a rectifier for you, we first make a fractional analysis of the gasoline and then build the rectifying unit so that it is specially adapted for that particular gasoline, and at the same time is flexible enough to be used with other gasolines.

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Natural Gasoline Plant and Refinery Equipment

With ERECO Rectifying Equipment any desired gasoline, such as aviation gasoline, liquid propane, liquid butane, or butane-free gasoline may be produced—exactly as required. Due to properly proportioned exchange surfaces and other exclusive features, fractionation is unusually efficient.

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Another

THE natural expansion of a successful business prompted Midwest to establish, in 1927, a plant on the Pacific Coast to serve more effectively the fabricated piping requirements of the far West.

In 1928, Midwest acquired the Urbauer-Atwood Company . . . piping contractors with a significant record of accomplishment throughout the Middle West over a period of more than 30 years.

Now Midwest has taken another important step forward. It is the consolidation with The Ballwood Company . . . piping fabricators since 1905. The shops of the Ballwood Company are at Passaic, New Jersey; their capacity will be materially increased and hereafter they will be known as the Ballwood Division of the Midwest Piping & Supply Co., Inc.

Users of power plant, industrial process, and oil refinery piping throughout the country can benefit from the unexcelled store of piping experience, the increased facilities, and the economies of large scale operation that result from this consolidation.

MIDWEST PIPING & SUPPLY CO., INC.

Plants at—ST. LOUIS - LOS ANGELES, and PASSAIC, N. J. (Ballwood Div.)

Offices: — ST. LOUIS, 1450 S. Second Street
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A Greater MIDWEST

Step Forward

THE Ballwood Company has fabricated piping of all kinds for central stations, industrial plants, oil refineries, railroads, hotels, etc. Among the many users of Ballwood piping are:—

United Light & Power Co. . . . . (Hellgate Station)
New York Edison Co. . . . . (14th Street Station)
Brooklyn Edison Co. . . (Gold St. and Hudson Ave. Stations)
New York Steam Corp. (Kips' Bay and Burling Slip Stations)
Texas Company . . . (Power House at Port Arthur Refinery)
Detroit Edison Co. . . . (Delray and Connors Creek Stations)
Pennsylvania Hotel . . . . . New York City
Lehigh Valley Railroad Co.
Westinghouse Electric & Mfg. Co. . . . East Pittsburgh, Pa.
Warner-Quinlan Co. . . . . Warners, N. J.

Piping Service

Mention Where You Saw the Advertisement

EASTERN REFINERS SPRING MEETING

production, leaving 140 millions to ship, an increase of 32 per cent. over 1928."

"Those graphs," commented the boss as he arose, "are a series of peaks and valleys, but they certainly help me anticipate peaks of prosperity and valleys of depression."

And now just a few random citations of the value of graphs.

Toward the end of 1925 kerosene was neglected and stocks began to drop abruptly. A certain company bought and manufactured lots of Oklahoma 41-43 W. W. when it was between four and five cents and sold it between eight and nine one-half. Were you so foresighted?

PREDICTING THE FUTURE

During the last few years a certain Mid-Continent refining group beseeched the Interstate Commerce Commission for reduced freight rates on refined oils from points of origin in the Mid-Continent to various areas East and South. Hundreds of exhibits were introduced, weeks of time consumed, and hundreds of thousands of dollars expended. The examiners report was recently issued. Here in ten letter-size graphs is the gist of his findings, a resume of the entire stupendous case.

At the beginning of 1928 we extended into the future the peaks and valleys of gasoline demand and estimated the total demand for the year would be 15,850,000,000 gallons. It was actually 15,966,000,000 gallons. Error seven-tenths of one per cent.

We extended the crude production plus imports line and estimated new crude for 1928 at 986,000,000 barrels. The actual was 980,000,000 barrels. Off seven-tenths of one per cent..

We predicted that crude stocks at the end of 1928 would be 488,000,000 barrels. They turned out to be 485,000,000 barrels. Error one-half of one per cent.

Such are a few of the uses of commercial graphics. I hope it shall be within the province of the National Petroleum Association to help the industry secure even better and quicker statistical reports than are now available, and then I hope that each and every one of you will build these figures into moving pictures, if you are not already a "fan" for movies of this kind. They will be real 100 per cent. talkies, for they will speak out to you and point out to you the peaks and valleys of the future.

Big Lake Oil Company, which is operating a natural gasoline plant on its producing properties in the Big Lake field, West Texas, produced a total of 4,838,559 gallons of natural gasoline during 1928, and the plant is credited with showing a profit for the year, before depreciation, of $111,671.09. This plant was the first major installation made in the district to operate on sulphur bearing gas, and is showing increased production annually.

"I never believed in coupons until I wrote for this FREE trial on

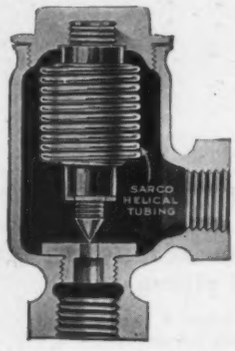
Sarco Steam Traps"

"There's a hunch for you, Charley," exclaimed Frank Donovan as he came to a Sarco advertisement. "I've seen those Sarco 30-day free offers for years, but I always thought they were just some sort of advertising dodge."

"Finally, I sent in a coupon to see what would happen. A few days later along came the Sarco Steam Trap. I followed directions and simply screwed it into the line without making any adjustment, as they said it was self-adjusting for steam pressures from 0 to 100 lbs."

"It must have done its stuff, Frank; I notice you've got them all over the place."

"I'll say it did," answered Donovan. "Why, the way that little trap automatically drained the line and sent the condensate back to the hot well before it had time to even cool off, was a surprise to me. And the big thing is that the entire installation didn't cost us a cent."



"How come," answered the other engineer.

"Well, they only cost around a third the price we've always paid for other traps and they trapped our lines so effectively that they cut tons of coal from our costs. They paid for themselves out of savings. *Now they are earning dividends.*"

The above is typical of hundreds of Sarco stories. You, too, will be a booster for Sarco if you try just one trap. Please mail the coupon.

Sarco Co., Inc.

183 Madison Ave., New York, N. Y.

Boston, Buffalo, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, St. Louis

Peacock Bros., Ltd., Montreal
Walker Crosweller & Co., London, S. E. 1

Sarco Co., Inc.,
183 Madison Ave.,
New York City

Send a Sarco Steam Trap on 30 days' free trial as follows:
( ) Size ..... for pressure ..... lbs.
( ) Send booklet No. S-230.

Firm .....
Street .....
City ..... State .....

SARCO STEAM TRAP

CUP GREASE MANUFACTURING METHODS

(Continued from page 96)

This grease maker uses a single kettle, having a working capacity of 1400 gallons, and consequently, about 10,300 pounds of grease are made in one batch.

Briefly, the process of manufacture is as follows:

One hundred gallons of mineral oil, all of the lime (which has been freshly slaked and then screened into the grease kettle), and 125 gallons of horse oil are first placed in the kettle on the afternoon of the day preceding the one on which the grease is to be made.

The whole is brought to a boil, stirring continuously, and cooked in this manner for between one-half hour and one hour, adding more mineral oil as necessary to cool the contents of the kettle. Steam is then turned off the kettle, the final mineral oil for the afternoon added, and the batch allowed to remain undisturbed until the following morning.

In the morning the remainder of the horse oil, 100 gallons, is added to the kettle. Enough steam is turned into the jacket of the kettle to melt the soap, after which agitation is started. Thereafter, in order to finish the batch as quickly as possible, full steam pressure is maintained on the jacket of the kettle. Small quantities of mineral oil are added to the kettle from time to time.

The batch is cooked until the grease contains the essential quantity of water, after which the steam is turned off the kettle and the addition of the final quantity of warm mineral oil started. The batch is finished in approximately the same way as in the procedure previously described.

Another grease-maker makes a lime soap of tallow and either horse oil or soya-bean oil fatty acids. Five parts of tallow to three parts of horse oil or soya-bean oil fatty acids is the ratio in which the fatty oils are used.

In making all cup greases this manufacturer makes use of two kettles, the one located directly above the other. Kettles of two different sizes also are used: the one has a working capacity of 40 barrels, the other of 12 barrels. When the kettle of larger size is used, approximately 62 per cent. of the total amount of mineral oil to go into the batch is added in the upper kettle. With the smaller batches, about 65 per cent. of the total amount of mineral oil is added in the upper kettle.

The general procedure followed by this grease-maker is as follows:

One hundred gallons of mineral oil, all of the fats, and the proper quantity of chemically hydrated lime for the complete saponification of the fats, together with 120 gallons of water, are added to the upper kettle.

The specifications on the mineral oil used (25° paraffin oil) are as follows: (Table 10.)

Table 10

Specifications of One Grease-Maker for Mineral Oil Used in Making Cup Greases

Gravity °A. P. I.	27-29
Flash °F., minimum	365
Viscosity at 70°F., seconds, minimum	360
Pour test °F., maximum	30
Color, N. P. A., maximum	4

While the lime is being added to the kettle — the lime being added over approximately a half-hour's period of time—the steam pressure

Refractory Efficiency

—at lower cost!

Athens Brick & Tile Co., Athens, Texas

Texas Clay Products Co., Malakoff, Texas

Elgin Butler Brick Co., Austin, Texas

Acme Brick Company Ft. Worth, Texas

LONG on refractory efficiency, short on freight expense! That's the sum total of the benefits the Southwestern Refiner derives through the use of this locally manufactured product—

TEXAS FIRE BRICK

A Quality serving more than 85% of fire brick uses. You get brick of precisely the refractory efficiency you require. And the short freight haul cuts the cost.

Write any Association Member for Figures on Your Requirements

TEXAS FIRE BRICK MFRS. ASS'N

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PROGRAM of Enqineerinq for Safety . . . in Oil Crackinq

Four years ago the A. O. Smith Corporation entered the field of Cracking Still fabrication with a definite program of Engineering for Safety in oil cracking.

Scientific predetermination of stresses under working conditions eliminated the old hazard of operation.

Security, unknown before, has been brought to the enterprise of oil cracking.

Many developments and extensions of cracking processes have been accomplished with SMITHWelded Vessels that would have been impossible with vessels made by any other means.

A. O. SMITH CORPORATION
Oil & Gas Field Products Division
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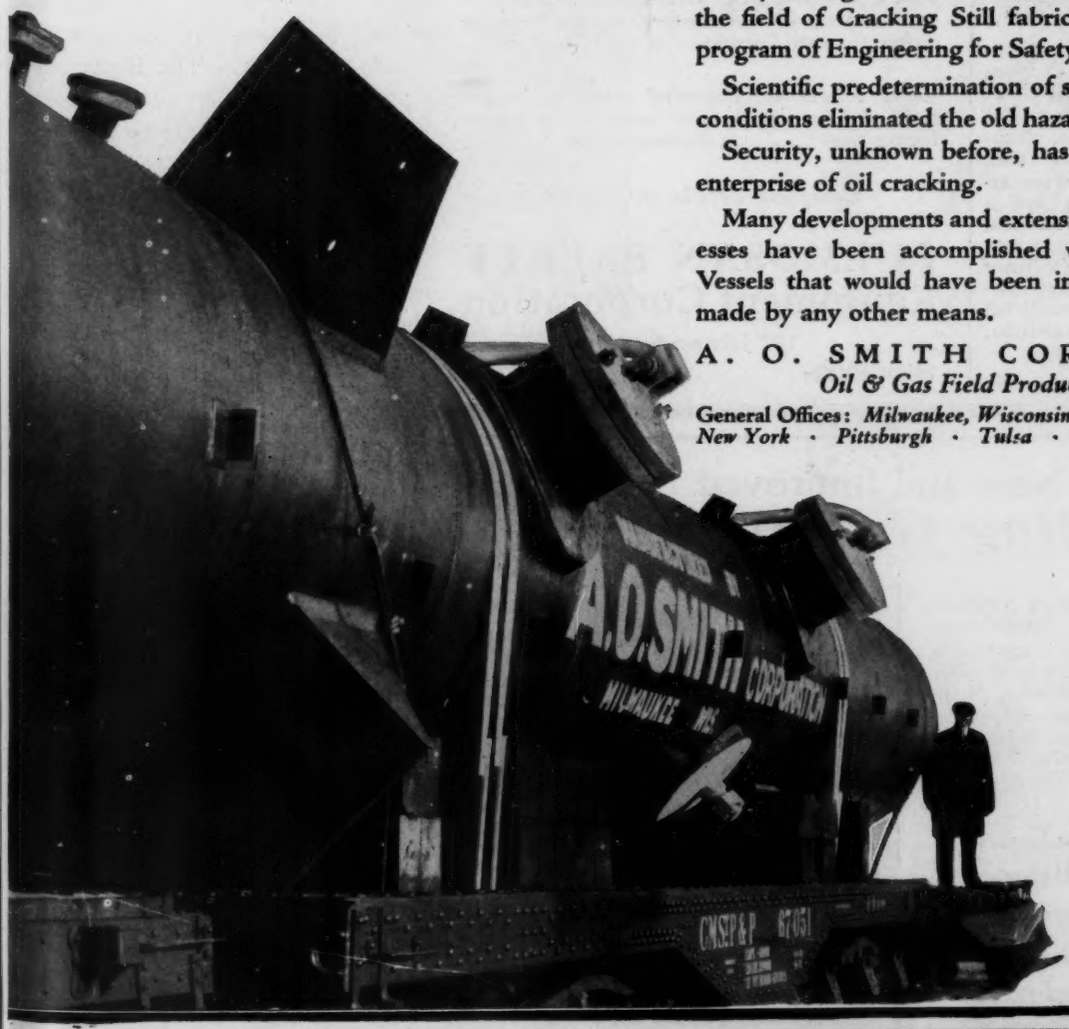

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PULMOSAN
CHEMICAL CARTRIDGE
RESPIRATOR

You are SAFE

—in deadly, poisonous fumes, and *know you are safe* with the Pulmosan Chemical Cartridge Respirator.

This type (illustrated) received the *highest* rating for safety (99.7% efficient) by the National Safety Council Committee in an official test.

Other factors are improved features of comfort, and interchangeable parts which assure longer wear . . . . yet Pulmosans cost no more!

Complete details on request.

PULMOSAN SAFETY
Equipment Corporation
182 Johnson Street,
BROOKLYN NEW YORK

SPARKS are DANGEROUS

Pulmosan AMPCO Non-Sparking tools will eliminate the fire hazard in your spray booths, cleaning rooms, tanks, tank cars, etc. . . . where inflammable fumes are a daily menace to life and property. Superior to brass or copper (will not squash or flake); practically as tough as steel! All styles. Write for circular.

A New and Improved
Recording Gravitometer

Designed to give accurate corrected gravities of natural, artificial or mixed gases. It is a rugged, dependable instrument which is easily and economically operated. Numbers of instruments now in operation giving satisfactory results and aiding in the Accurate Measurement of gas.

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Gas Gravity Balance
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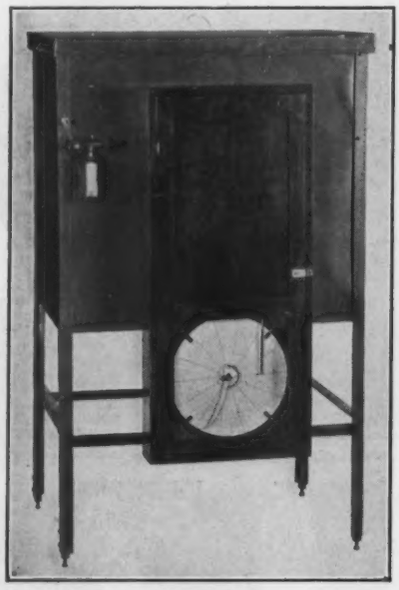

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Write for detailed information.
Bulletin No. 2A.

Largest Scientific Material House in the Southwest
THE REFINERY SUPPLY COMPANY
Fourth and Detroit Streets
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3404-06 Main Street
DALLAS, TEXAS

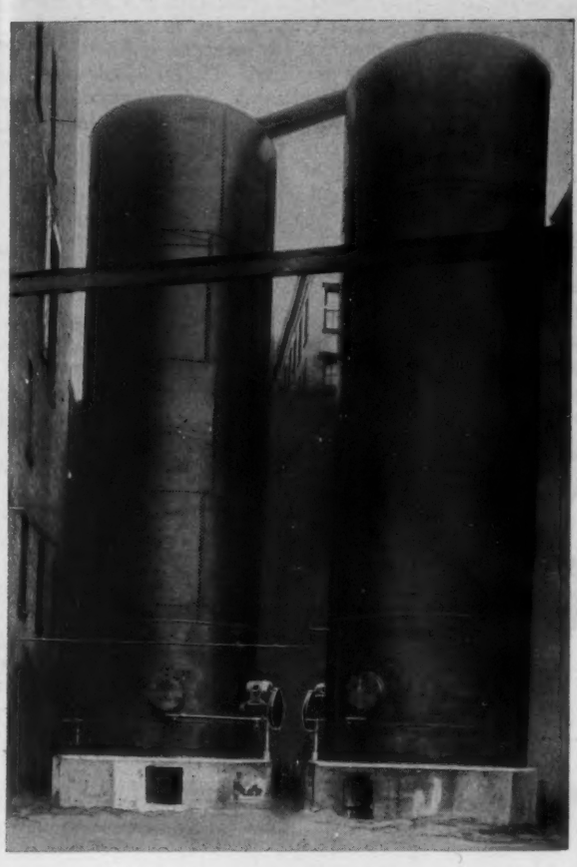
on the jacket of the kettle is maintained at about 15 to 20 pounds. Upon the addition of all the lime, this pressure is increased to 55 to 60 pounds. The batch is crooked for four or five hours, or until the proper amount of water is present in the grease. About one-half hour before finishing the batch in the upper kettle, the remainder of the mineral oil that is to be incorporated in the grease in the upper kettle is added.

The grease is drawn into the lower kettle at temperatures ranging between 220° and 250°F., this depending to a certain extent upon the fluidity of the grease. The grease passes through a strainer as it is drawn into the lower kettle. The higher temperature at which the grease is drawn from one kettle to the other, the more water is required to be added to the grease in the lower kettle.

The grease is finished in the lower kettle, the final mineral oil being added, with constant agitation, until the product is of the proper consistency. The first 100 gallons of mineral oil is pumped into the lower kettle fairly rapidly, requiring only from 5 to 10 minutes; thereafter, the oil is added more slowly. After stirring for about one-half hour in the lower kettle, cooling water is turned into the jacket of the kettle and the batch cooled down to a point nearer the drawing temperature. The temperature at which this grease-maker draws his batch varies between 167° and 185°F., and will average approximately 176°F.

Phillips Petroleum Company is erecting a high pressure absorption gasoline plant to handle about 20,000,000 cubic feet of natural gas daily in the Pampa field, Gray County. This plant is to be located in the east one-half of Section 32, Block B-2, H&GN survey on the Finley-Brown farm, and near the semi-wildcat oil producer completed in March by Marland Production Company. The latter strike is to be the principal gas source, but a number of additional tests are assured for the immediate area.

The Edward Valve & Manufacturing Company, East Chicago, Indiana, manufacturers of power plant and refinery valves, are now represented in Baltimore by D. C. Elphinstone, Inc., 120 South Calvert Street.



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MIXERS

are furnished in either Stationary or Portable Type

FOR FIXED INSTALLATIONS THE SIDE ANGULAR PROPELLER TYPE IS FURNISHED FOR TANKS OF ANY SIZE OR SHAPE. REQUIRE LESS POWER, TAKE LESS SPACE, ALWAYS IMMEDIATELY ACCESSIBLE AND 100% EFFICIENT SIMPLE-DEPENDABLE.

GEARED AND DIRECT DRIVE PORTABLE TYPES FOR ALL FLUID PRODUCTS. CLAMP ON TANK OR ANY OTHER MIXING CONTAINER. HOT OR COLD PROCESS. TANKS, OPEN OR CLOSED, PRESSURE OR VACUUM.

Extensively used in the Oil Refining Industry.

Lightnin Mixers are patented both as to method and structure.

INVESTIGATE CLAIMS AND AVOID INFRINGEMENTS.

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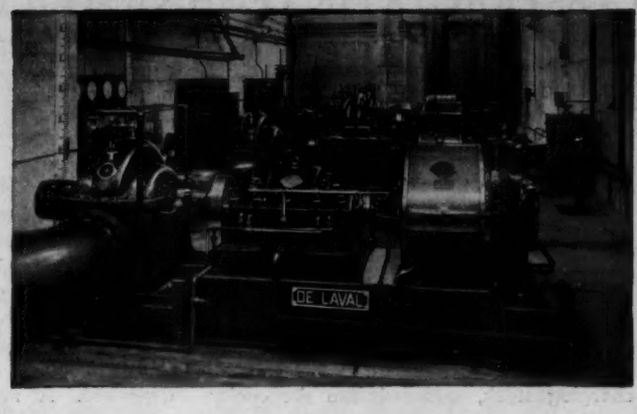

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THE two De Laval geared turbine driven units in the foreground deliver 7,500 gals. per min. each against 68 ft. head. The turbines receive steam at 80 lbs. gage pressure and exhaust to process apparatus against 5 lbs. back pressure. The power for pumping is thus obtained as a by-product at practically no cost. The two De Laval fire pumps in the background are directly connected to their turbines, and deliver 4,900 gals. per min. each against 340 ft. head.

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ABSTRACTS OF TECHNICAL LITERATURE
Of Particular Interest to the Plant Operator
By H. L. KAUFFMAN

Cracking

Cracking in the Vapor Phase. Auld. (*Petroleum Times, Jan.* 19, 1929, *p.* 99 *and Jan.* 26, 1929, *p.* 158).

The Hall process was operated during the war with the primary object of producing aromatics and especially toluene as a basis for explosives. Solar oil, the charging stock, was fed into the cooler portion of a coil of one-inch tubing 600 feet long and heated and vaporized gradually in its passage through the coil till it came to a sudden enlargement of the tube. Here the vapors expanded to atmospheric pressure, the temperature, it was claimed, rose somewhat higher, cracking took place, and considerable carbon was deposited. A maximum temperature of 550-660°C. (1022-1112°F.) was maintained when cracking for motor fuel. For aromatics a temperature of 750°C. (1382°F.) was required. The cracked vapors were conveyed away to dephlegmator and compressor. The gasoline contained about 42 per cent. of aromatics, including 17.5 per cent. of toluene. Enormous amounts of gas were produced and the wasteful process was discontinued after the war. The principles learned from the operation of the Hall process have been formulated by De Florez recently, however, who emphasizes the importance of keeping the vapors in rapid turbulent flow in small tubes for the better heat transference. The important factor in vapor-phase cracking is high temperature; the influence of pressure is secondary; 500°C. (932°F.) may be taken as the boundary line between liquid and vapor-phase cracking.

The Rittman process worked at temperatures high enough to vaporize the oil completely under pressures of six atmospheres and more. Vertical tubes of 12-inch inner diameter were used, and heat transfer and control were very poor.

The Ramage process is now being revived and improved. The oil vapors are mixed with steam and passed over a metal oxide, usually iron oxide. The saturated hydrocarbons are oxidized and the reduced catalyst is exodized again, possibly in accordance with the equation: $C_nH_{4n}+2$ (paraffin) $+ Fe_2O_3 \rightarrow 2CnH_{3n}$ (olefin) $+ H_2O + 2FeO$. Or C_nH_{4n+2} (paraffin) $+ 7Fe_2O_3 \rightarrow 2CnH_{2n-6}$ (aromatic $+7H_2O+14FeO$ $2FeO+H_2O \rightarrow Fe_6O_3+2H$.

Very little carbon is deposited.

Twenty years ago Noad and the New Oil Refining Process, Ltd., and Nielson had a process which consisted at first in dropping oil and water upon hot scrap iron in a retort. But they later turned to other contact materials such as coke, bauxite, and refractory materials without recognizing the special value of the metal oxide.

The Ramage process has operated steadily in a small way in Canada from its beginning, as the Gyro process, until its superiority over the liquid-phase cracking processes as a producer of non-knocking motor fuel brought it into prominence. It is the only method now in operation for producing anti-knock material from petroleum by the normal refinery methods. The gasoline has 50 per cent. of the anti-knock value of pure benzol. The process has been fully developed by the Pure Oil Company at its Cabin Creek, West Virginia, plant. It is also in use by the Union Carbide and Carbon Company, the Great Lakes Refining Company, and the McColl-Frontenac Oil Refining Company, Ltd.

* * *

News of the Cracking Industry. (*With References*). *Singer.* (*Petr. Zeitschr., Feb.* 10, 1928. *Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 9, *pp.* 84-85. Bourgoin and Bourgois describe the process of cracking at atmospheric pressure, the treatment of the products, and the refining of the gasoline.

Le Chatelier reports upon the cracking of ozokerite, Cross upon the production

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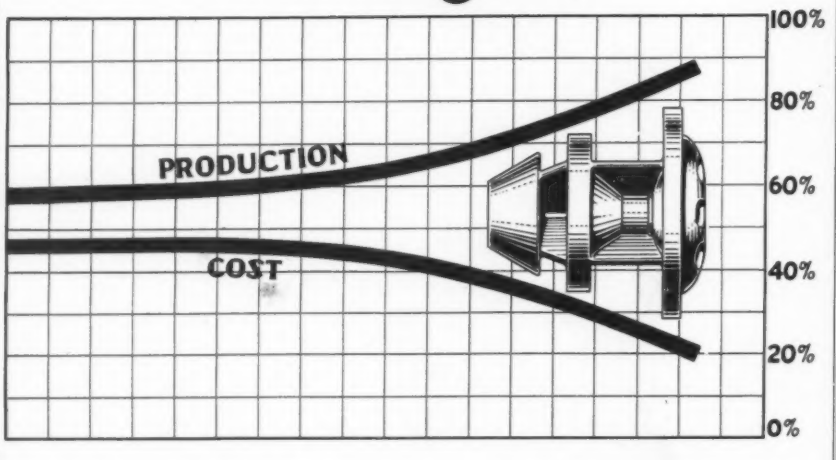

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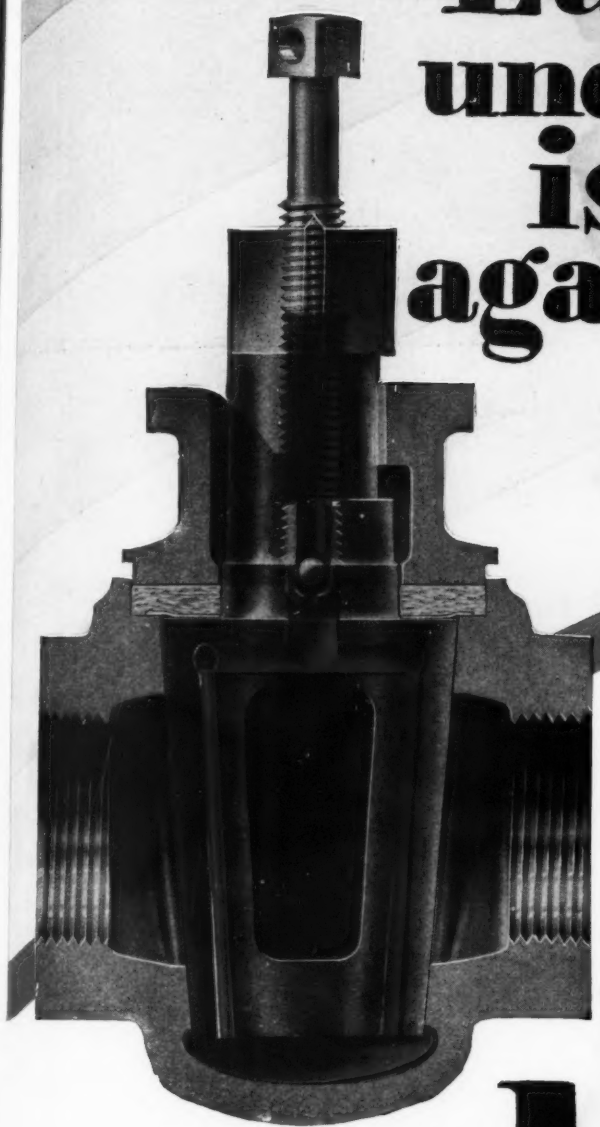

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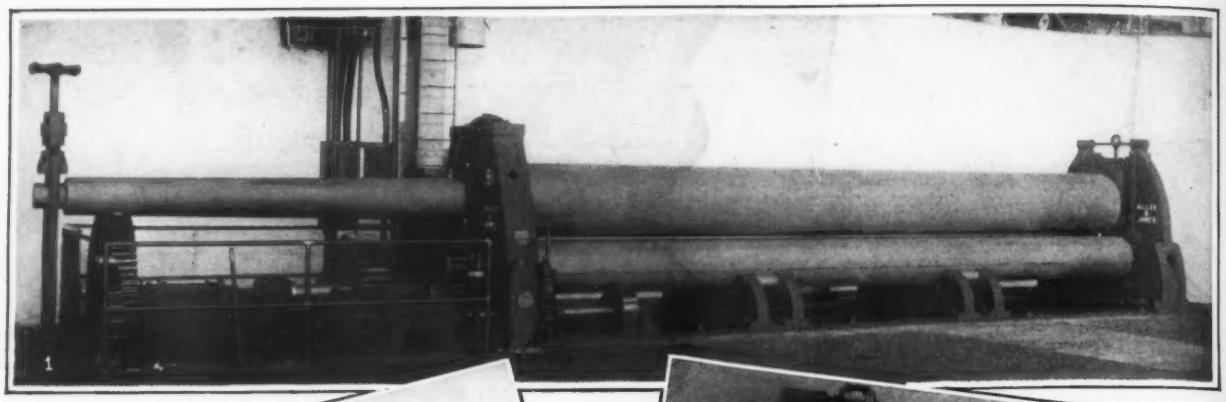

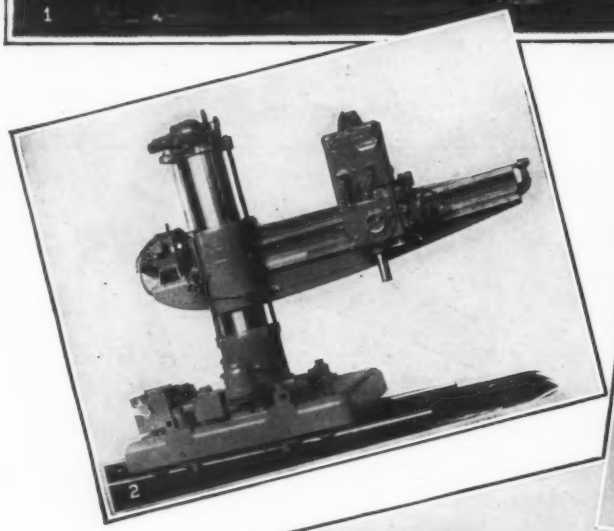

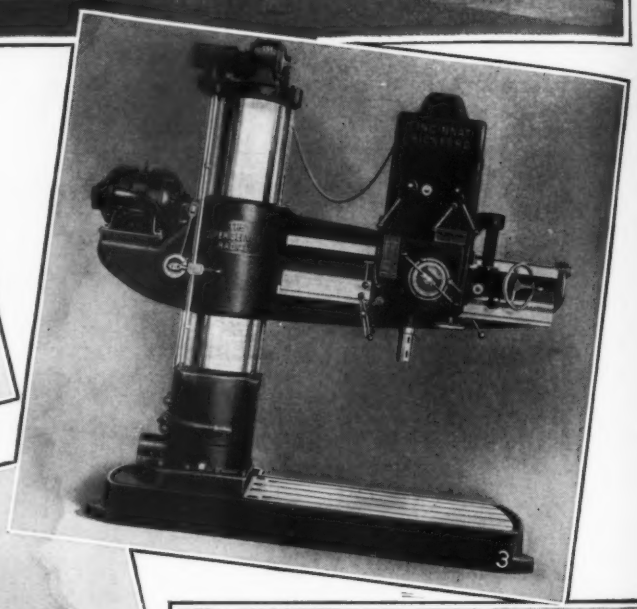

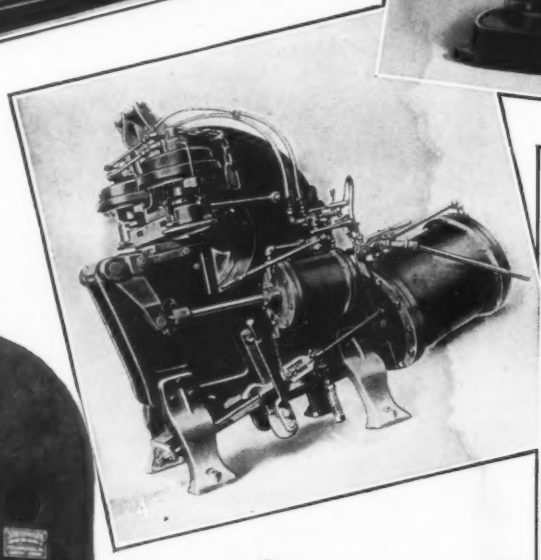

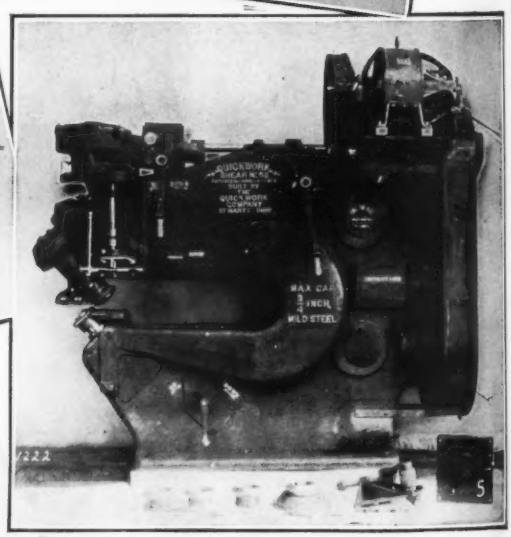

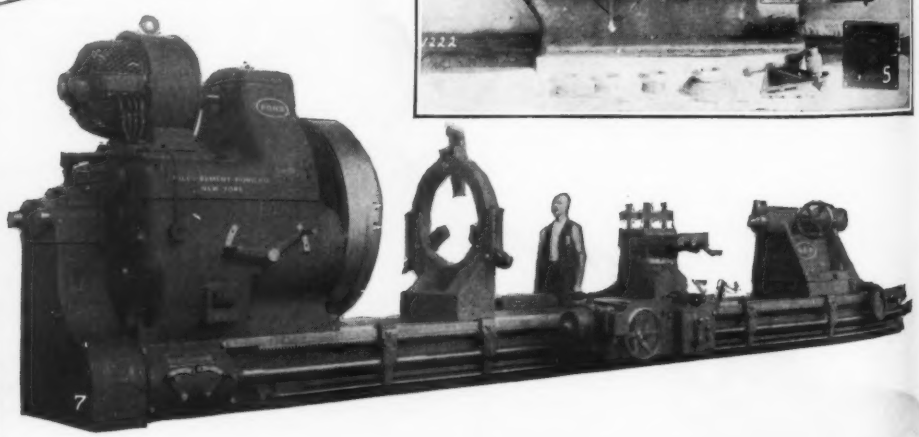

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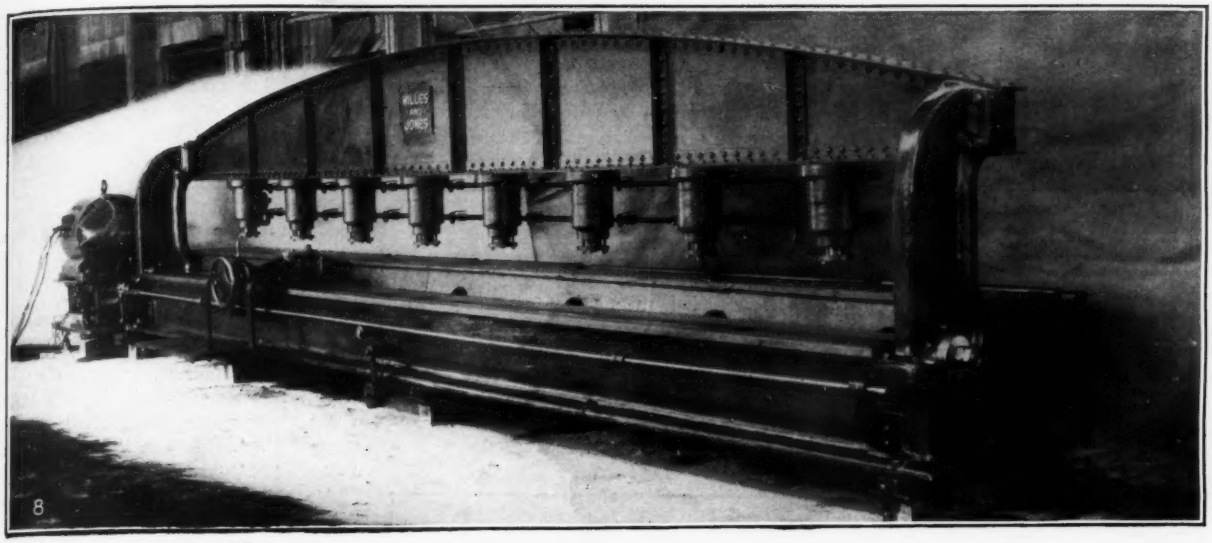

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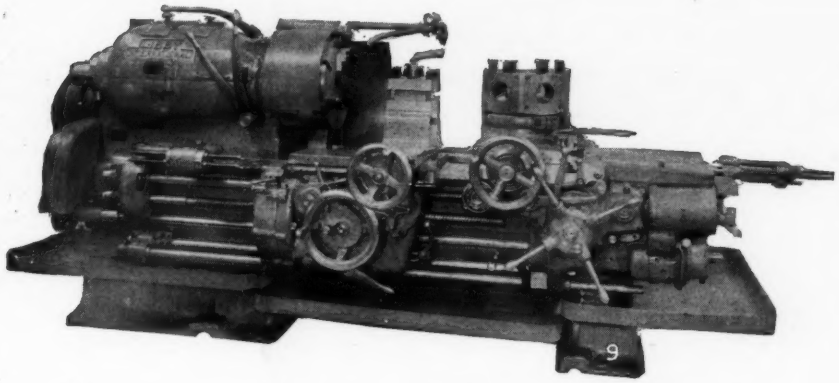

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of gasoline from shale oil; the latter shows that sulfuric acid is not as suitable for refining the cracked gasoline from shale oil as to treat the vapors with earth or clay pre-treated with copper; metallic sodium also gives good results. The shale gasoline is said to have marked anti-knock quality. Gault and Barman, studying the pyrogenic decomposition of hexadecane and hexadecene under pressure at 500-600°, find that the quantity of gas produced rises till a pressure of three kilograms per square centimeter is reached, and remains constant to nine kilograms. The quantity of liquid decreases with temperature and pressure. Dobrjanski and Murejewa undertook to crack petroleum in the liquid-phase at atmospheric pressure and at 405-415°. Machine oil, cylinder oil, vapor oil, and paraffin were also broken up. The quantity of ethylene and heavy hydrocarbons produced decreased with advancing decomposition, while that of saturated hydrocarbons increased. It is probable that the long side-chains of the cyclic hydrocarbons first broke off, and then further splitting led to the formation of other saturated hydrocarbons. Cracking was not affected by manganese dioxide, coke, or copper or iron filings.

Stratford inquired into the action of aluminum chloride upon hexahydroaromatic and saturated aliphatic hydrocarbons. The hydrocarbons derived from cyclohexane give the corresponding methyl compounds by treating with aluminum chloride. The aliphates decompose between the fourth and fifth carbon atom giving butane carbon chains. If the chain is longer than octane it forms two molecules of butane and an unsaturated residue.

The modern Cross installation at the Medway refinery in England, described by Oil Engineering and Finance, cracks kerosene under 700 pounds pressure in reaction chambers capable of withstanding 2000 pounds pressure. The kerosene is mixed with an equal quantity of run-back, flows over the dephlegmator into the furnace, passing through this in seven minutes and coming up to 930°F.; it then flows through the reaction chamber 42 feet long for one-half hour. It passes from there through a reboiler and then at 670°F. to an evaporator held at 20 pounds pressure.

According to Szanyna, Boryslaw gas oil gave 27 per cent. of gasoline at the highest temperature used for cracking, but 46 per cent. by the Bergius process and 44.4 per cent. when aluminum chloride was used. The quantity of unsaturates remains almost unchanged, that of aromatics increases, of saturates diminishes; the naphthenes disappear, the paraffin content rises. Increased pressure does not influence the gasoline yield, but increases saturation. Hydrogen is absorbed in the Bergius process at high pressure. Only aluminum chloride acts as an accelerator; active carbon and nickel do not. Using tubes of different materials the optimal temperature increases in the sequence of heat conductivity copper, iron and quartz.

Egloff and Morrell report a yield of 78 per cent. of gasoline by the topping of Seminole crude and then cracking by the Dubbs process.

* * *

Treating

The Desulfurizing Action of Silica Gel. 111. *Waterman and Tussenbroek. (Brenstoff-Chemie, Dec.* 15, 1928, *p.* 398. *Libr. Bull., U. O. P. Co., Vol.* 4, *No.* 3).

In two earlier communications has been reported the desulfurizing action of silica gel upon aliphatic sulfides, disulfides, and mercaptans. The order of magnitude of the action was about the same for all these compounds. It is now proposed to take up the behavior of silica gel with reference to aromatic sulfur compounds, thiophen, and colloidally and molecularly dissolved sulfur. The aromatic compounds used were: diphenyl sulfide, dibenzyl sulfide, and benzyl mercaptan. A stable colloidal solution of sulfur in kerosene was made by the method of Garard and Colt. (J. Amer. Chem. Sec. 1927), but it contained only 0.126 per cent. of sulfur. A molecular solution of sulfur was prepared by heating flowers of sulfur with kerosene. This solution contained 0.5 per cent. of sulfur. The silica gel was made in the same manner as in the previous experiments.

The solutions were shaken with 20 per cent. by weight of silica gel for six hours at temperatures varying from 30.7° to 33.7°. The diphenyl sulfide originally contained 1.012 per cent. of sulfur, lost 0.138 and 0.132 per cent. depending upon size of gel granules; dibenzyl sulfide so-

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lution, showing originally 1.117 per cent. of sulfur, lost 0.286 to 0.307 per cent.; benzyl mercaptan solution, containing 0.794 per cent. of sulfur, gave up 0.206 to 0.225 per cent.

The literature, and particularly the conclusion drawn by Wood, Sheely, and Trusty (Ind. Eng. Chem. 1926), would indicate that thiophen is not adsorbed by silica gel. Waterman and Tussenbroek found, however, that the sulfur content of the thiophen solution was reduced from 0.939 to 0.815, 0.807, 0.841, and 0.800 per cent., again depending upon the granule size of the gel. The colloidally dissolved sulfur dropped from 0.126 to 0.006 per cent.; the molecularly dissolved from 0.550 to 0.014-0.001.

The action of the silica gel upon the kerosene itself was tested by determining the aniline point before and after treating with the gel. The kerosene before treatment with concentrated sulfuric acid had an aniline point of 53.3°; after, 71.2°. This corresponds to an aromatic content of 21 per cent. When the untreated kerosene was shaken for six hours with silica gel the aniline point rose to 54.4°-54.5°. From this rise it was concluded that the gel adsorbed the aromatics preferentially.

* * *

NATURAL GAS AND GASOLINE INDUSTRY

Alternative Methods of Blue-Gas Enrichment. Kleinschmidt. (Ind. and Eng. Chem., September, 1928, *p.* 909).

The oil-refining industry now uses so large a portion of the gas oil fraction for cracking that the gas industry is receiving an increasingly inferior product from which to enrich its blue gas; and on the other hand the modern refinery yields by-products which could advantageously be used as enrichers. Among the available enriching materials are; gas oil, for which under present conditions a heating value of 100,000 B.t.u. per gallon is probably a high figure; coal gas with a fuel value of 600 B.t.u. per cubic foot or 750 B.t.u. if produced by the K. S. G. low temperature carbonization process; natural gas, 1000 B.t.u. per cubic foot; refinery gases, 1200-1800 B.t.u.; the very light fractions of the natural gasoline now marketed as G. E. gasoline and having the highest heat value of any hydrocarbon vapor now commercially available for gas enrichment. There is also the possibility of synthesizing methane from the blue gas itself without great energy loss.

Three-quarters of all the gas oil used for gas enrichment is used in the eastern and northeastern part of the United States. Any competing material would have to be delivered to this section. But it is probable that it will increasingly be found more profitable to treat the gas oil at the refinery. Coal gas can be made in unlimited quantities, but this will be economically limited by the demand for coke for domestic heating and the convenience of the market for the by-products, ammonia, coke, and tar. Natural gas could be supplied to the gas works of Denver, New Orleans, and St. Louis, but could not replace gas oil as an enricher on the Atlantic seaboard. Refinery gas from the great refineries in Bayonne and Brooklyn could supply a large part of the requirements of New York; and the refineries at Wood River could serve St. Louis similarly. This gas is stated to be of such value for the gas works that the refineries could afford to sell it and pay $15 a ton for bituminous coal as fuel. If the butanes and propane were stripped from the refinery gases they could be transported in liquid form to the small gas works. The equipment necessary for making these enriching materials available would be simple except that for the synthesis of methane, which is still undeveloped. A vapor phase cracking plant, with its high gas yield, non-knocking motor fuel, and limited production of heavy oils and tars, might profitably be operated with the primary purpose of making enricher gas.

Costs per therm are calculated and curves are shown which indicate the relative value of the various gases for enrichment. It is to be noted from these curves that the higher the heat value of the enricher gas, the greater the proportion of the total heat value of the enriched gas which comes from the blue gas.

* * *

RESULTS OF RESEARCH AND INVESTIGATIONAL WORK

Motor Fuels. Hill. (Ind. and Eng. Chem., Vol. 19, *No.* 10, *pp.* 1114-15).

Gasoline yield from crude oil has increased from 12 per cent. in 1929 to 37 per cent. in the 1926. This has been due (1) to the extension of the boiling range of gasoline; (2) to the recovery of gasoline from natural gas; (3) to improved refinery fractionating equipment; (4) to decreased refinery losses; but, chiefly, (5) to the "cracking" of heavy oils into lighter and more volatile petroleum hydrocarbons. The quality of the gasoline has been improved during this same period primarily in that the "knocking" tendency has been reduced. Bergius and Fischer processes of making motor fuels synthetically, former by hydrogenating coal, latter, from water-gas, are commented upon briefly by the author. These processes are looked upon as means by which gasoline substitutes can be produced in the future.

* * *

A Study of Petroleum Lubricants. Mabery. (Ind. and Eng. Chem. Vol. 19, *No.* 4, *pp.* 526-29).

Commercial lubricants are defined by initial distillation, proportion distilled below 3000° C., 30mm. specific gravity and viscosity of the distilled products, and stability on a friction-testing machine. The heaviest hydrocarbons of refinery distillation are separated and analyzed.

Two oils subjected to heavy use, one on a truck and one on an airplane, were examined as to specific gravity, viscosity and behavior on a frictional bearing. The used oils were found to have undergone little deterioration. Oils with the same viscosity showed wide variations in frictional tests.

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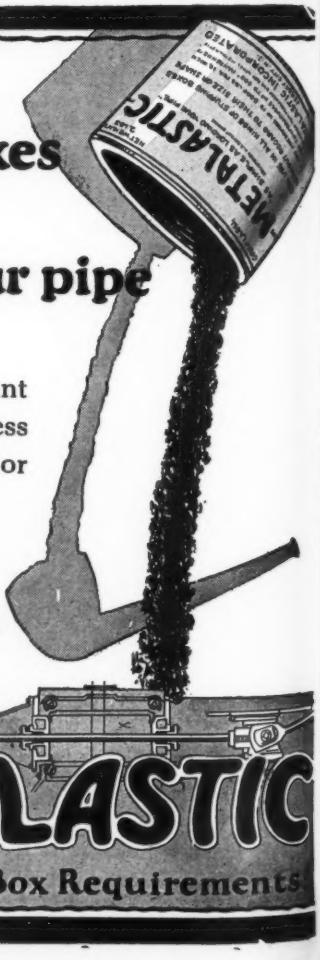

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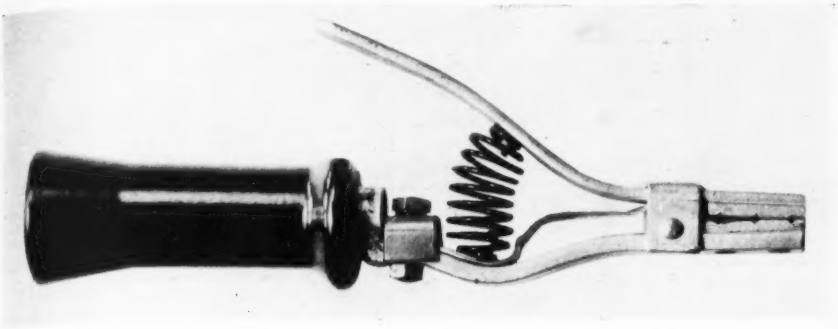


New Electrode Holder

LINCOLN ELECTRIC COMPANY

The Lincoln Electric Company, Cleveland, Ohio, announces an improved type of electrode holder for metallic arc welding designed for greater operator convenience.

The holder consists essentially of a powerful clamp to hold the welding electrode firmly while welding and with an easy release feature which permits changing electrodes quickly.

The handle grip is designed for easy holding and it is claimed that the holder operates exceptionally cool, because the welding current is carried from the point of cable entry to the copper jaws by copper strips of low resistance.

In the older types of holders, the high amperage welding current was carried through the steel frame of the holder itself and uncomfortable heating frequently resulted under continuous service.

The copper tips on the jaws reduce the sticking of the electrode to the jaws resulting in faster and easier change of electrodes and longer life for the holder.

The shape of the holding clamps has been altered to give greater compactness to permit work in close corners.

All metallic parts of this holder are coated with non-tarnishing cadmium plating. Each holder is packed in an individual carton which facilitates shipping and storage.

The holder is known as the Improved Type T Electrode Holder.

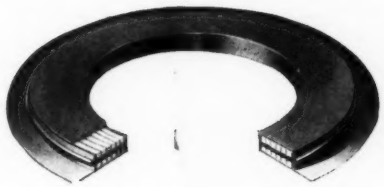
High Pressure Gasket

FLEXITALLIC GASKET COMPANY

Flexitallic Gasket Company, Camden, N. J., has just announced a gasket for taking care of high pressure, high temperature and even acid conditions. Condensation in the lines has no effect, making it invaluable for plants carrying a variable load.

The improvement consists of a simple one piece metallic armor which is spun around the "Flexitallic" gasket. The accompanying illustration shows all of the details of how the armor clad "Flexitallic" is constructed.

This gasket is now being offered to the public encased in a one-piece metallic armor, giving it a greater factor of safety than was possessed by the original "Flexitallic." It is stronger and



the elastic limit is higher. The maximum capacity of the testing machine—100,000 pounds—the elasticity of the gasket is not exceeded, which is equivalent to about 9000 pounds per square inch.

Now, equipped with armor, the strength and resiliency of this improved gasket is such that it may be used over and over indefinitely.

The armor is made of thin aluminum, which offers the rust resisting and acid resisting qualities, capable of withstanding high temperatures, and electrolitically is neutral.

Another advantage possessed by Armor Clad "Flexitallic" is the "web" which extends out to any width desired depending upon the inside diameter of the bolt circle. For example if the inside diameter of the bolt circle is 10 inches and the inside diameter of the pipe is six inches, the Armor Clad "Flexitallic" is made in such a way that the gasket proper fits almost flush and concentric with the opening of the pipe, being held in place by the web which in turn is supported by the bolts.

"Man's Conquest of The Air" is a new booklet recently published by the Midwest Air Filters, Inc., Bradford, Pennsylvania, by Stig G. Sylvan, M. E. research engineer, Midwest Air Filters, Inc., and Professor Samuel E. Dibble, Carnegie Institute of Technology. This booklet devotes 20 pages to the story of purifying air by scientific methods.

Barreling Unit

S. F. BOWSER & COMPANY

An automatic, pre-determined quantity Xacto Meter barreling unit designed for use where lubricating, transformer, engine and cylinder oils and liquids of similar characteristics are being barreled has just been announced by S. F. Bowser & Company, Fort Wayne, Indiana.

The device is selective and can be set to measure and discharge either one of three different quantities of 30, 50 or 55 gallons with an additional pint when it is desired. When the quantity for which the mechanism has been set is dispensed, the valve in the discharge automatically closes, stopping the flow. An automatic counter maintains an accurate record of the number of containers filled. This counter records to 10,000 in numbers of containers and then repeats. It cannot be set back.

The temperature and specific gravity control is of particular interest because it solves a problem wherever liquids of different temperatures and specific gravities have been barreled. This unit, which can be manipulated by the average workman, compensates for the expansion and contraction of the liquids and insures accurate measurement based on 60 degrees Fahrenheit.

The speed of discharge is sufficient

Rubshell

FOR

Inside of Tanks

WITHSTANDS

H_2S & H_2SO_4

and other corrosives met with in Refineries

THE ONLY PAINT TRIED, TESTED and USED EXTENSIVELY by the PRINCIPAL COMPANIES

Also for condensers, agitators, kettles, exchangers, etc.

STOP THAT CORROSION TO-DAY!

VOLCO

HOLZAPFEL'S HEATPROOF PROTECTIVE

WITHSTANDS

RED HEAT!

Use it on any surface too hot for other paints

Extensively used for hot smoke stacks, exhaust pipes, mufflers, etc.

NEW YORK
RUBSHELL, INC.
25 Broadway

TULSA, OKLA.
NATIONAL SEAL CO.

HOUSTON, TEXAS
RUBSHELL, TEXAS, INC.
Post-Dispatch Bldg.

that one operator with one of these units can fill approximately 50 30-gallon containers, 35 50-gallon containers, or 30 55-gallon containers in an hour.

Literature completely describing this unit is ready for distribution to those interested.

The new Enduro KA2 stainless steel has recently replaced the Enduro 18-8 steel as supplied by Central Alloy Steel Corporation and Babcock & Wilcox Tube Company. Ludlum Steel Company is producing the improved material by the same processes in its own mills and is marketing it under the same name.

By means of new methods of processing, now made available in this country through license rights, these steels now represent the work of the improved processes and new methods of heat treatment. Produced under Krupp Nirosta patents and under the supervisory direction of Professor Doctor Benno Strauss, director of research, Fried. Krupp A. G., Germany, the three companies mentioned above are licensed to operate under the patents.

Enduro KA2 is processed to resist air, water, dilute solutions and acids at high temperatures and at high pressures. It can be deep drawn, wire drawn, spun, readily machined and welded by either electricity or gas. One of the outstanding features is its adaptability to taking polish to a mirror surface. It is made as non-magnetic and has approximately the ductility of copper. It is now available in all standard forms from the three manufacturers licensed to produce it.

Raymond M. Sievers has recently been appointed district sales manager of Harbison-Walker Refractories Company, St. Louis, and will be in charge of the district west of the Mississippi River to the Rocky Mountains.

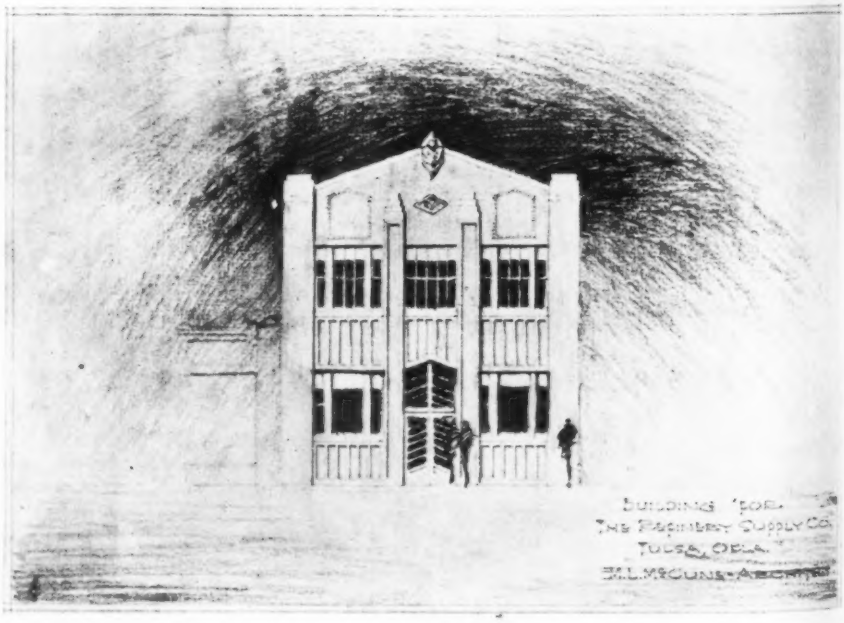
Mr. Sievers, a native of St. Louis, has been a member of the American Refractories Institute since its organization. He was connected with the Evans & Howard Firebrick Company of St. Louis from 1904 to 1928, in 1917 becoming sales manager in charge of firebrick sales and in 1925 elected vice president and a director.

R. M. SIEVERS

Safety Lamp

MINE SAFETY APPLIANCE COMPANY

The new Edison Model "F" electric safety cap lamp placed on the market by the Mine Safety Appliances Company of Pittsburgh, Pennsylvania, is equipped with the two filament gas filled bulb of which the only source of power is the 81-ounce battery built with an actual capacity of 16 ampere hours. The Model "F" lamp offers an increased illumination over previous Edison models. The headpiece is a lightweight moulded and reinforced Bakelite, moisture proof and dust proof and weighs three ounces less than the Model "E" Edison headpiece. The battery contain-



By June 1, 1929, the new home of the Refinery Supply Company, 625-627 East Fourth street, Tulsa, will be completed. The building, two stories, of brick, steel and reinforced concrete, will be so constructed that four additional stories may be added. The plans provide for sufficient parking space for customers.

The new building will be large enough to accommodate both the sales and maufacturing facilities of the company. The products to be manufactured will include angle and plain projectors for pipe lines, balancers, oil feeds, charcoal tube adapters, gravitometers, orifice well testers, etc.

Lagonda Cleaners

They break down the scale barrier that prevents proper heat transfer. They clear up clogged tubes and pipes. They prevent burning and overheating.

Use them for cleaning all sorts of tubes, pipes, etc.

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO
FUEL SAVING SPECIALISTS
NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND, CINCINNATI, DETROIT, SYRACUSE, BALTIMORE, ATLANTA, ST LOUIS, KANSAS CITY, DENVER, DALLAS, SAN FRANCISCO, MONTREAL, LONDON

Besides Tube Cleaners for Boilers, Condensers, and all sorts of tubes, Lagonda makes a very effective Cap and Header Reseating Machine, a Cleaner Feeding Device for curved tube boilers, a Boiler Tube Cutter of merit. Ask for details.

X-1448

Clean driveways at half the cost

OIL and grease-spotted filling station driveways do not attract customers. Realizing this a certain oil concern adopted a regular cleaning schedule for the driveway of one of its stations. But, when soap powder was used, costs were high.

Then an Oakite material was applied and allowed to soak on the concrete for a few minutes. Oil and grease spots were scrubbed and the whole surface rinsed with a hose. A better job was obtained.

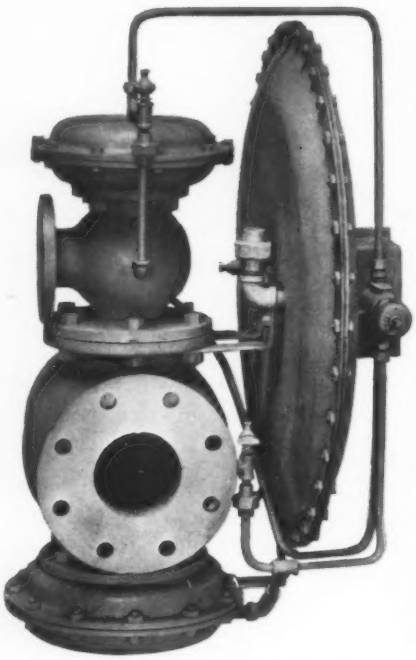
No matter whether your particular problem includes cleaning concrete floors or removing caked-on oil from field equipment you can do the work better and more economically the Oakite way. Our nearby Service Man is ready to prove it. Write and ask us to have him call. No obligation.

Oakite Service Men, cleaning specialists, are located in the principal industrial centers of the U. S. and Canada

Manufactured only by
OAKITE PRODUCTS, INC., 50B Thames St., NEW YORK,

OAKITE
TRADE MARK REG. U. S. PAT. OFF.
Industrial Cleaning Materials and Methods

WILCO VALVES



WILCO TANK CONTROL

Scores of installations in the California fields have proven this regulator.

The WILCO TANK CONTROL may be placed on the tank roof if desired, or it may be installed on the ground.

One regulator will operate equally well whether connected to one tank or to a group of tanks.

A WILCO TANK CONTROL will allow all the gasoline laden vapors to pass to the gathering line when gas is being generated and it will allow sufficient Dry gas to enter to prevent a vacuum being formed in the tank when gas volume shrinks.

ATMOSPHERIC pressure may be maintained or the regulator may be set to maintain slight pressure or slight vacuum.

BUILT IN ALL SIZES OF CAST IRON OR STAINLESS STEEL TRIMMED.

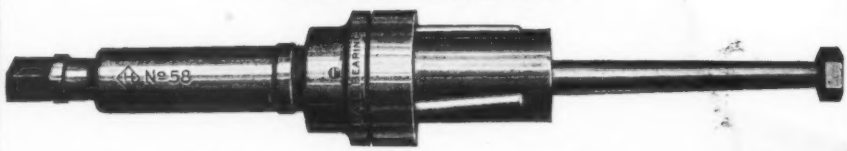
SIMPLE-COMPACT-RUGGED
EXTREMELY SENSITIVE

WILKINSON CONTROLLER CO.

5700 SANTA FE AVE. LOS ANGELES, CALIF.

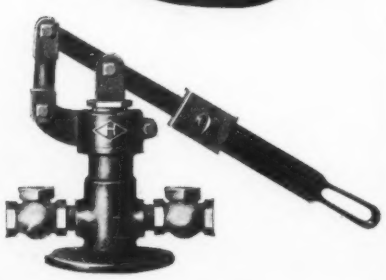
WILCO VALVES

Heavy Duty Expanders for Still Tubes



Tools for the Oil Industries

Hydraulic Pressure Pumps, 8000 pounds
Tube Expanders for Cracking Still Tubes
Hydraulic Pressure Pumps, 2000 pounds.
Tube Expanders for Condenser Tubes
Hydraulic Pressure Pumps, 500 pounds.
Tube Expanders for Steam Boilers
Screw Punches for Structural Shapes
Tube Expanders for Pipe Work
Screw Punches for Plate Work
Flaring Tools for Still Tubes
Beading Tools for Still Tubes
Hydraulic Jacks
Hydraulic Punches



A. L. HENDERER'S SONS

Wilmington, Del.

Established 1870
Expanders since 1884

er, monel metal, non-rusting, cannot be opened except in the lamp house.

If the glass of the bulb becomes accidentally broken, the safety mounting of the bulb breaks the circuit and the filament ceases to glow, preventing ignition of the gaseous mixture.

The Model "F" lamp has been approved by the U. S. Bureau of Mines and will take the place of previous Edison models on the bureau rescue cars.

Full details may be obtained from a bulletin published on the Model "F" lamp by Mine Safety Appliances Company, Braddock Avenue and Thomas Boulevard, Pittsburgh.

PAINT BULLETIN

Hill, Hubbell & Company, San Francisco, has published a new 168-page catalog in loose-leaf form describing its paints serving the producing and refining branches of the industry. The paints, varnishes, enamels, biturine coatings and special technical paints are illustrated in all colors by sample pastings along with reading matter.

Examples of Hill, Hubbell & Company's paint jobs are given in photographs carried in this catalog, including jobs on tank ships and tank cars, pipe lines and various field equipment.

A copy of the catalog may be secured by writing the company.

AWARDED TROPHY

The Mine Safety Appliances Company, Pittsburgh, was awarded the Cecil G. Rice Safety Trophy at the annual banquet of the safety school conducted by the Western Pennsylvania Safety Council, which was held at Syria Mosque, March 11. The banquet was attended by more than 1800 men and women from the industrial plants of the Pittsburgh district who had completed the safety lecture course.

Phil G. Fenlon of the Duquesne works of the Carnegie Steel Company acted as toastmaster and Frank L. Duggan, president of the Western Pennsylvania division, presided. The principal speaker was Frank Phillips, vice-president of the Philadelphia company.

The Cecil G. Rice trophy is awarded annually to the company in Western Pennsylvania having the best safety record for the previous year and is much sought after by all member companies of the National Safety Council. The announcement that the Mine Safety Appliances Company had won the award this year was received with great enthusiasm as this company is dedicated to safety, being engaged entirely in the manufacture of safety appliances. There is considerable hazard involved in their work as it has to do largely with providing protection against poisonous and explosive gases. They are continually working with these gases and many of their employees are engaged in the dangers of rescue and recovery work after mine explosions and mine fires. In view of this, their winning of this safety trophy is quite an accomplishment.

Seatless Valve

SCHUTTE & KOERTING COMPANY

Shutte & Koerting seatless valves less valve design eliminates flat or beveled seat faces, and obtains the shut-off being obtained by a cylindrical plunger sliding vertically through two special packing rings separated by a bronze cage with ports through which the steam or other liquids flow when the valve is open. The piston of the bronze plunger is regulated by a standard handwheel and screw spindle.

The seatless valves are easily opened and closed due to the sliding action.

The stuffing box and its nut are used to compress the packing rings to insure a close fit around the sliding plunger. Worn packing rings may be removed by a special tool to hook under the lower ring.

Schutte & Koerting seatless valves are made in both globe and angle patterns, screwed and flanged ends. They are designed for pressure up to 250 pounds.

Bulletin 8-T, Volume 6, describes this seatless valve in detail and may be had by writing the company at Philadelphia, Twelfth and Thompson Sts.

Heat Proof Protective

INTERNATIONAL COMPOSITIONS COMPANY

"Volco," Holzapfel's heat proof protective, manufactured by the International Compositions Company, Inc., of New York City, is represented by the company to withstand 1800 degrees Fahrenheit while withstanding prol able damage from gasoline or water. "Volco" was introduced by the manufacturers into Texas fields early this year for distribution through Rubshell Texas, Inc., headquarters in the Post-Dispatch Building, Houston.

Reading Iron Company has established an office at 402 Mutual Building, Kansas City, Missouri, which will be in charge of H. D. Pollard. This move was effective March 15. Effective April 1, John G. Cottle, who for a number of years was attached to the sales staff of Reading Iron Company's Chicago office, will assume the duties of railroad sales representative in the Chicago and western territory. He succeeds H. L. Shepard, resigned. O. L. McGinn has been engaged as salesman attached to Reading Iron Company's Chicago office, effective April 10.

A Tight Seal

With "V" Pilot Packing

ON high or low pressure, "V" Pilot Packing provides a tight seal on the rod and gives long, dependable service.

Distributors listed below stock "V" Pilot Packing in spiral form in 10-foot lengths. A trial of "V" Pilot will indicate its adaptability for your service. Get in touch today with the nearest distributor, or if you wish, write us direct.

Distributors

BEAUMONT, TEXAS
Norvell-Wilder Hardware Co.
BUFFALO, NEW YORK
Buffalo Mill Supply Co.
CHICAGO, ILLINOIS
O. C. Keckley Company
DENVER, COLORADO
The Mine & Smelter Supply Company
FORT WORTH, TEXAS
Norvell-Wilder Hardware Co.
HOUSTON, TEXAS
Texas Rubber Specialty Co.
LOUISVILLE, KY.
Graft-Pelle Co.
PITTSBURGH, PA.
Argo Asbestos & Rubber Co.
ST. LOUIS, MISSOURI
J. P. Bushnell Packing & Supply Company
SHREVEPORT, LA.
Norvell-Wilder Hardware Co.
TOLEDO, OHIO
Hardy & Dischinger
TULSA, OKLAHOMA
Mid-Continent Sales Service Company

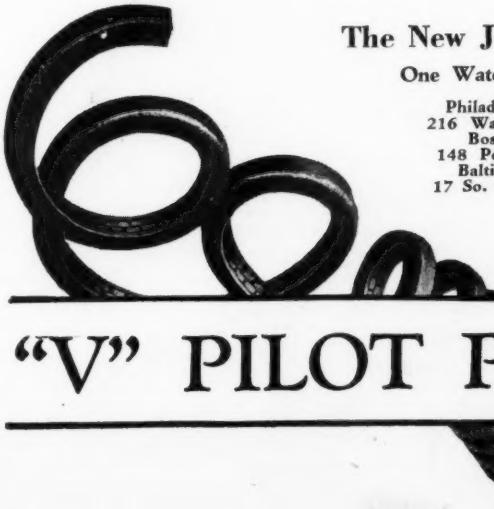
"V" Pilot does not require constant drawing-up of the glands to hold pressures. Instead, the flexible back of "V" Pilot expands and holds the Packing in place; the bar conforms to the rod and has the advantages of metallic packing with the pliability and ease of handling of soft packings.

"V" Pilot Packing is a semi-metallic packing with a continuous, solid "V"-shaped flexible bar, backed by resilient asbestos. The metal face reduces friction to the minimum, while the resilient asbestos back compensates for the vibration of the rod.

Throughout the refinery and natural gasoline plant, you can more generally standardize on "V" Pilot than any other one packing. It reduces packing stocks, and will help you lengthen packing service and minimize replacements. A trial of "V" Pilot can readily be arranged, through the distributor near you or with us direct. Write today.

The New Jersey Asbestos Company
One Water Street, New York, N. Y.

Philadelphia
216 Walnut St.
Boston
148 Pearl St.
Baltimore
17 So. Gay St.
Norfolk
111 E. Main St.
San Francisco
37 Spear St.
Wilmington, Cal.
236 Avalon Blvd.



"V" PILOT PACKING

For cracking process in oil refineries we furnish Aluminum Armored Asbestos filled Gaskets and Corrugated Armco Iron or Monel Metal Asbestos encased.

Copper rings 3/16" thick for 4 and 5" O. D. tubing.

Washers or gaskets made of Aluminum, Copper and other Metals.

Write for Prices.

METALLO GASKET CO.

NEW BRUNSWICK, N. J.

Pittsburgh

AIR PRESSURE TESTED Coils

A Good Coil

Look for this tag on all your Pittsburgh Coils.

EACH Pittsburgh-built Coil is tested under air pressure while submerged in water. Proved secure, it is numbered and tagged for identification—and for your protection. One more step to assure to you complete coil satisfaction.

Have you had a recent quotation on Pittsburgh Coils? Send blue print or rough sketch.

Pittsburgh Pipe Coil & Bending Co.

P. O. Box 975, PITTSBURGH, PA.

Proportioning Pump

HILLS-McCANNA COMPANY

Hills-McCanna Company of Chicago has just recently developed a new L Type Proportioning Pump. The L series needs no introduction since they have been in treating and general metering service for a number of years. The feature of the new pump is the plunger, which is guided to eliminate all possibilities of distortion when used in high pressure service

The assembly illustrated was especially designed for pumping sulphuric acid in metered quantities. It will handle capacities ranging from 5 to 60 gallons per hour against pressures up to 400 pounds per square inch.

FOXBORO TULSA OFFICE

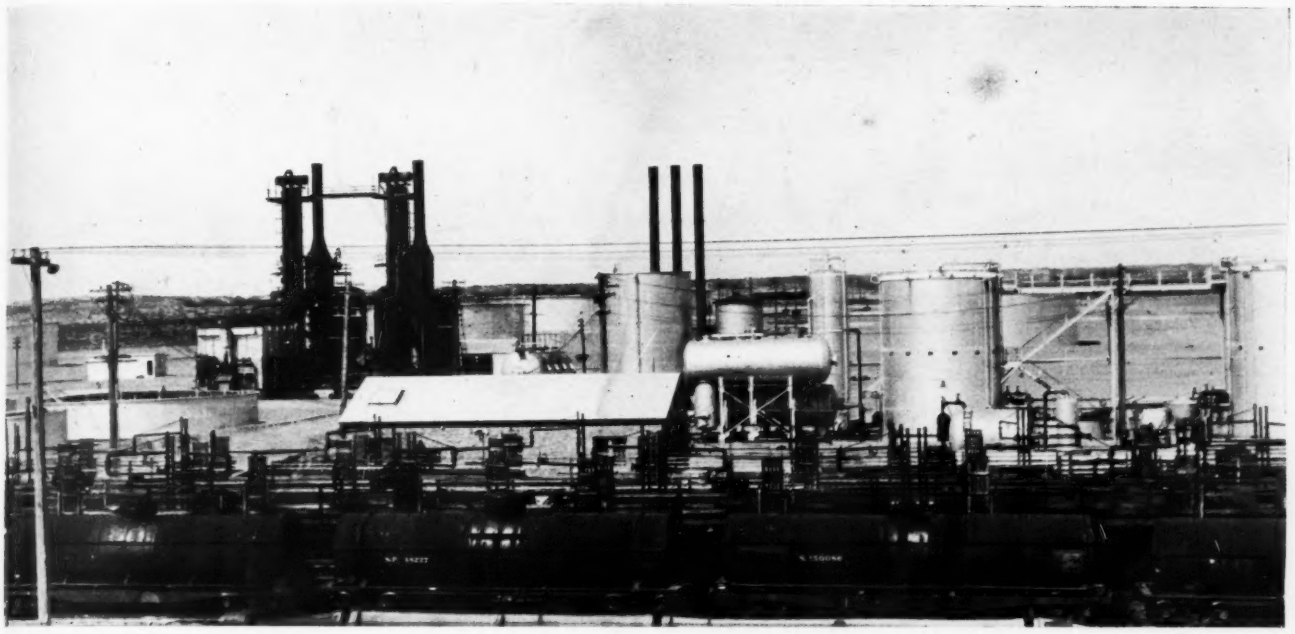
The Foxboro Company of Foxboro, Massachusetts, has recently opened a branch office in Tulsa, at 28 North Guthrie Street, which will serve as the Mid-Continent headquarters for the company. The new location gives the Foxboro double its former floor space, with 5000 square feet. It provides for a completely equipped instrument repair shop, facilities for assembling certain types of instruments of special design on which prompt service is required and provides more working room. J. B. McMahon, Foxboro manager in the Mid-Continent territory, has increased both the engineering and sales personnel.

TRANSFORMER BULLETIN

Wagner Electric Company, 6400 Plymouth Avenue, St. Louis, has issued a new bulletin, No. 164, devoted to transformer performance. It is a 12-page bulletin describing the method of making tests on transformers to determine their acceptability and the calculations of operating characteristics from the test data. A copy will be mailed upon request to the company at the above address.

The Bristol Company, manufacturers of Bristol recording instruments, Waterbury, Connecticut, has just issued a new catalog covering the company's automatic electric control valves, including the motor operated and the magnet types. It is 20 pages and illustrated with photographs and drawings of Bristol equipment, and punched for insertion in loose-leaf folder with former bulletins of this company. With the catalog is a folder carrying the complete price list, and a sheet for automatic control data. A copy will be mailed upon request to the company.

News of Refinery and Gasoline Plant Activity



General view of Pasotex Petroleum Company's new 14,000 barrel refinery near El Paso, Texas

PASTOTEX Petroleum Company is operating its 14,000 barrel capacity refinery at El Paso, Texas, on Winkler County crude delivered to the plant through the pipe line of the Pasotex Pipe Line Company. Both of these companies are 100 per cent. owned subsidiaries of Standard Oil Company of California.

The El Paso refinery is the first to be built by Standard Oil Company of California outside of its native state. It was erected to supply an expanding trade in Texas, New Mexico, Arizona and Mexico. Pasotex Petroleum Company has purchased Gulf Refining Company's service stations in and around El Paso.

This plant is the second refinery to be located at El Paso. Rio Grande Oil Company has been operating its refinery on the bank of the Rio Grande River close to the city for several years. This plant has recently been improved and its capacity increased to 3000 barrels daily.

The third refinery for El Paso is now under construction by The Texas Company and according to current reports will consist of a 1500-barrel tubular retort and one Holmes-Manley cracking unit with a capacity of 1650 barrels daily. Work on this plant is being rushed to completion and it should be in operation late this summer.

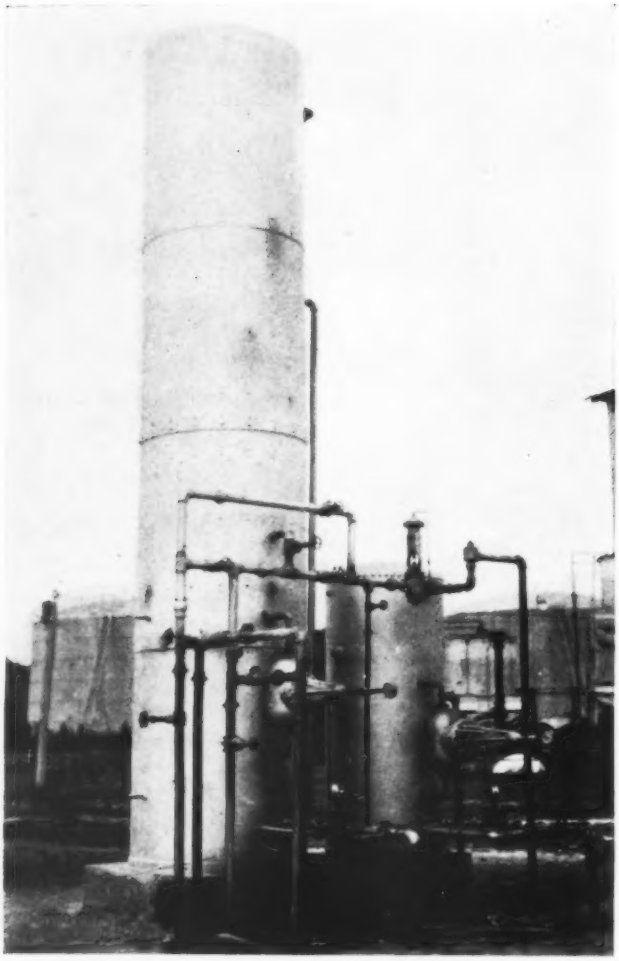
Combined refining capacity at El Paso, upon completion of The Texas Company's plant, will total 18,500 barrels.

Pasotex Petroleum Company's plant consists of two 7000-barrel tube stills of Standard Oil Company of California design, equipped with bubble type fractionating equipment, also of company design. All larger steel tankage is equipped with Wiggins floating roofs, and all tankage is painted with aluminum paint. Operating on Winkler County crude, the plant produces from 25 to 28 per cent. gasoline which is marketed under the trade name of Red Crown throughout the company's territory.

The plant is located about six miles east of El Paso and just outside of the district benefiting from the local irrigation project which means that the plant site and company camp is located in a desert country. The company general office building and laboratory, and the seven bungalows are all of brick construction as are the garages and other main buildings. The Texas Company's plant site is just across the highway south of the Pasotex plant.

Pasotex Petroleum Company is producing the usual skimming plant products with the exception of kerosene. No cracking facilities are planned at this time. The plant site is sufficient to allow expansion of skimming plant facilities or the erection of a number of cracking units and the plant is designed and constructed in such a manner that subsequent enlargement will not interrupt present operations.

The general office building and all seven of the company's employee's bungalows are constructed entirely of brick



Secondary Absorber Handles Tail Gasses at Magenta

A SECONDARY absorber is used by the Arkansas Natural Gas & Fuel Company (Cities Service) at its Magenta gasoline plant near Monroe, Louisiana, for extracting the gasoline from vapors and gasses derived from the accumulator and storage tanks, the look-box and from the loading rack.

This system of recovery of gasoline from so-called "tail-gasses" is interesting because of its simplicity, ease of control and as a comparison with tail gas gasoline recovery plants of the compression type. In a previous issue of THE REFINER AND NATURAL GASOLINE MANUFACTURER, May, 1928, page 62 the gasoline plant was fully described. It has the highest operating pressure in this country, since it passes gas through the primary absorbers at 650 pounds pressure, handling approximately 27,000,000 cubic feet of gas daily during July.

At the time of the previous writing the absorption type of gasoline recovery plant working on uncondensed vapors from the storage tanks was not yet perfected. A single stage compressor operating at 140 pounds pressure was extracting some of the gasoline from the tail gasses. The present tail gas recovery plant is an improvement over the single stage compression method.

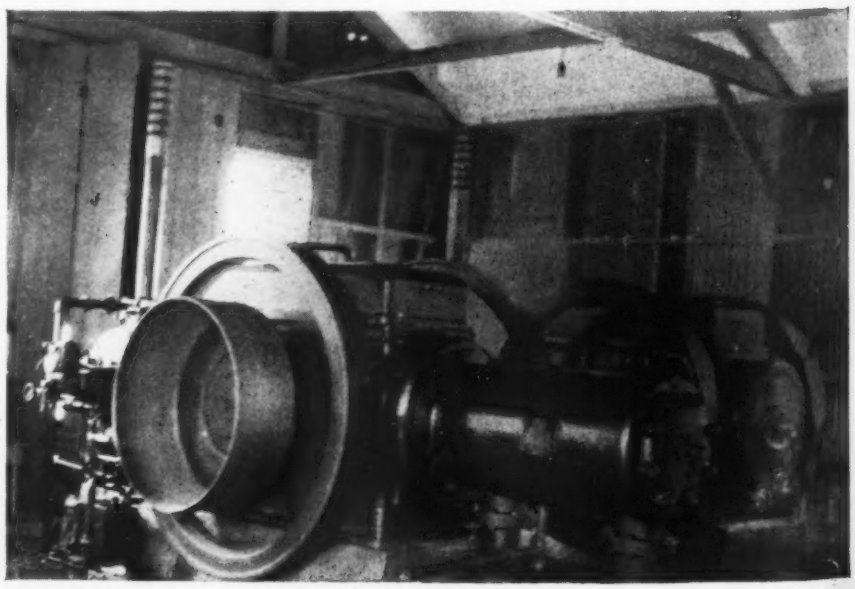
After the absorption oil is passed through the high pressure absorbers it is conducted to a vent tank before being subjected to the distillation procedure. At this point a small rotary pump takes suction on the partially enriched oil and discharges it to the secondary absorber. This absorber is controlled as to oil level by a Fisher Kidney type liquid level controller. As the oil accumulates in the bottom of the small absorber it flows into a second small vent tank, which is also under control by the same type of liquid level regulating device.

A Cooper, type 16, size 13 by 16 by 16 inch, gas engine compressor is employed to handle the tail gases from storage and accumulator tanks to the absorber. This machine boosts the rich vapors into the absorber at a pressure of 20 pounds. In their passage through the absorber the tail gases and loading rack vapors are stripped of their gasoline content, and pass out of the absorber to be vented to the fuel line and consumed under the boilers.

A recent test of the absorption oil leaving the high pressure absorbers checked against the further enriched oil leaving the tail gas recovery plant indicated an increase in saturation of .87 per cent.

The former practice of compressing the tail gasses to 140 pounds resulted in the condensation of a very wild product and the recovery was not so high as that secured by the absorption method. Operating the machinery at only 20 pounds as against 140 pounds and handling an increased volume of gasses, has proven to be much easier on the machinery, for its work has been reduced. Checking the total plant production against that formerly secured by the single stage compression and the production of the absorption plant proper, the operators find that present production through the use of the secondary absorber working on the tail gases, is materially increased.

In addition to the important factor of ease of operation, which is in fact, automatic, the absorption system of extraction of gasoline from the tail gasses has the advantage of very low first cost and low maintenance, and requiring hardly any attention from the operators. The gasoline absorbed from the tail gasses is not handled separately through individual still and condenser equipment, but is combined at the secondary absorber with the gasoline extracted from the original gas from the field. Thus the entire plant production is preheated, distilled, and condensed in the one system of equipment. This system also eliminates the necessity of blending back the product of the tail gas recovery plant with the "make" of the main plant—since this blending is done as the enriched absorption oil passes through the distillation unit.



Compressor Handling Tail Gasses

ANOTHER REFINERY ON HOUSTON CHANNEL

Tide Water-Associated Oil Company, through its active refining subsidiary, Tidal Refining Company of Tulsa, contemplates erection of a refinery at Houston, construction work to begin soon enough for the refinery to be in operation during 1930.

F. M. Hutchinson of Houston, who obtained an option on the Postel 700-acre tract at Deer Park about 30 days ago from the Postel estate, has assigned his option on this piece of ground to Tidal Refining Company. Transfer of the properties involves $455,000 or better.

According to C. R. Barton of Tulsa, vice-president of Tidal Refining Company, the land, which has a frontage of approximately 4500 feet on the Houston Ship Channel, will be used for terminal as well as refinery purposes. In this connection, Tide Water Oil Company, which controls the refining subsidiary, probably will dispose of a portion of its 25,000-barrel daily Mid-Continent production at the Houston refinery. As Tide Water Associated Oil Company has no pipe line from the Mid-Continent to Houston, carrier lines of other companies will be used for transportation of the oil to Houston. A similar means, together with utilization of tank cars, will be employed to move Tide Water Oil Company's 5000-barrel daily production from West Texas districts. The companies of Tide Water-Associated interests do not contemplate immediate construction of any pipe lines to Houston from West Texas or the Mid-Continent.

Tidal Refining Company's first unit at the Houston refinery will have a 15,000-barrel capacity. The design of plant that will be used was not known to Barton, but general practice of the Tide Water-Associated Oil Company's subsidaries elsewhere has been to build the "tube and tank" systems protected under the Ellis patents. Present plans known to Barton merely specify that it will be a topping and cracking plant. Cost of the first unit will be between $3,000,000 and $4,000,000, according to Barton.

West Texas crude now being produced by Tide Water Associated interests is being moved to Bayonne, New Jersey, at considerable expense. Terminal and refining facilities on the Gulf Coast will considerably decrease the margin between the cost of this oil at the well at that at the present Atlantic seaboard refinery. The same will hold ture with reference to that portion of the company's oil moved to Houston from the Mid-Continent.

Property on which the Tidal Refining Company's proposed refinery will be located is adjacent to the refinery site of the Shell Petroleum Corporation. While it fronts the Houston Ship Channel, it reaches back to the concrete highway running from this city to La Porte, on Galveston Bay, and is traversed by the Public Belt Railway right-of-way.

Carnegie Refining Company, Heidelberg, Pa., has about completed reconstruction of its filter plant and barrel house. During December, 1928, these departments were destroyed by fire. The new equipment going in is of latest modern design and will be ready for operation in June. H. S. Bell, refinery engineer, is consulting engineer for the company.

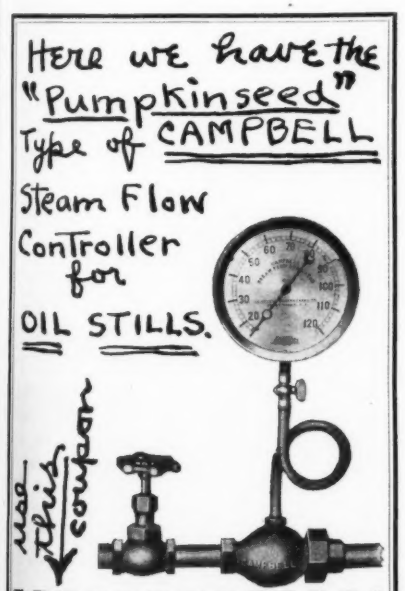
E. L. MILLER HEADS SHELL SALES DIVISION

E. L. Miller has been elected vice president in charge of sales for the Shell Petroleum Corporation, with headquarters at St. Louis. Mr. Miller formerly was connected with Shell Oil Company of California. He succeeds C. G. Woodruff, who resigned recently.

TEXAS PETROLEUM MERGER COMPLETED

The Texas Petroleum Company has been organized with a capital stock of $2,500,000 to absorb the producing properties, refinery and pipe lines of the Schimmel Production Company, Fort Worth, Texas Petroleum Products Company and Witherspoon Oil Company both San Antonio concerns, and will maintain headquarters in the Smith-Young Tower, San Antonio. The officers of the new concern are: V. G. Schimmel, president; C. Grover Shaw, 1st vice-president; Glenn R. Schimmel, 2nd vice-president; C. L. Meserole, secretary, and C. T. Lighthouse, treasurer. Other officials include: H. J. Kebodeux, superintendent production; J. H. Wyle, sales manager, and T. S. Shaw, traffic manager.

Schimmel Production Company's properties consisted of about 350 barrels in the Somerset field and about 50 barrels of settled production in the Central West Texas district, and a number of scattered wildcat leases and blocks. The office heretofore maintained by this concern at Fort Worth will be discontinued. Witherspoon Oil Company contributed about 150 barrels of Somerset production and a pipe line system through the merger. Texas Pe-



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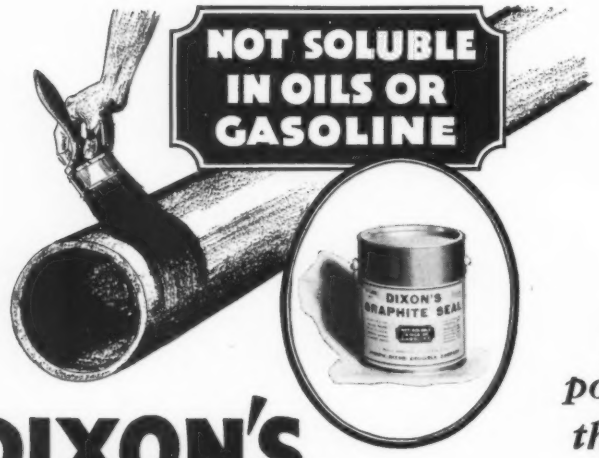

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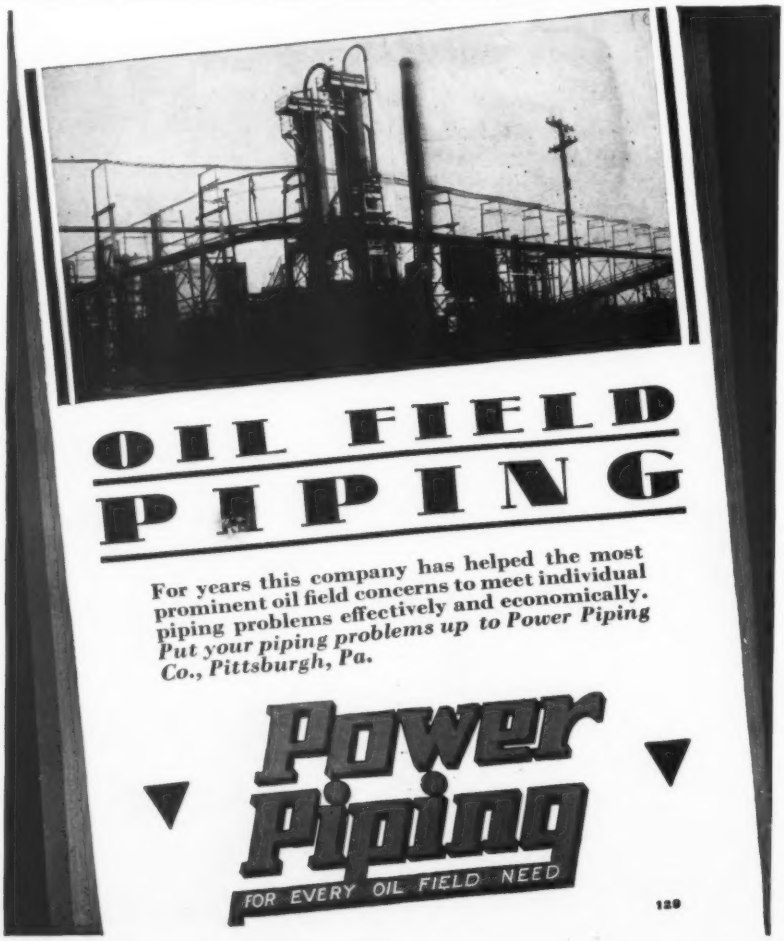
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129

troleum Products Company, which acquired the Somerset plant of the Witherspoon Oil Company about November 1, 1927, will also be dissolved. This plant is rated at 1500 barrels daily, and is to be enlarged by the new owners. George Dartois is superintendent of refinery operation.

FOSTER HEADS PHILLIPS TANK CAR SALES

M. E. Foster has been named manager of tank car sales for the Phillips Petroleum Company of Bartlesville, Oklahoma. He was for several years assistant sales manager. The appointment was announced by H. A. Trower, general sales manager of the company.

Mr. Foster will have charge of tank car sales of both the refineries and the natural gasoline plants of the company.

Another change announced was the appointment of R. C. Jopling as manager of the retail marketing department.

LaSalle Petroleum Company, (formerly Noble Oil & Gas Company) at its recent annual meeting of directorate elected John A. Prescott of Detroit, Michigan, as president of the company. W. J. Schnur was elected executive vice president. Mr. Schnur has been in active charge of company operations for some time. W. J. Coppinger is secretary and treasurer: R. B. Martin, assistant secretary and treasurer, and Edward Merrill Smith is chairman of the board. The company operates a 3500 barrel capacity skimming plant at Burkburnett and a natural gasoline plant at the same point. Construction of a 1500 barrel Jenkins cracking unit on the refinery site is progressing rapidly. J. B. Joyce, formerly of the old Texhoma refinery at Wichita Falls, is superintendent of plant operations.

John Lee Allen, assistant stillman, general manager and principal stockholder of the Amarillo Producers and Refiners Corporation, is in charge of construction of the company's new refinery at Del Rio, Texas, and of moving the equipment which the company formerly used in its Borger, Texas, plant to Del Rio, for use there. The plant at Borger was completed October 1, 1926, with 2500 barrels daily capacity, and has since been in regular operation; but it has been closed down and will be moved to Del Rio; where the company is now constructing a 2500-barrel refinery to be operated on West Texas crude supplied by the trunk line of the Illinois Pipe Line Company, which has a large tank farm at Del Rio. The Del Rio refinery, according to plans, will be in operation by April 1. The output of fuel oil will be used by the Southern Pacific Railroad Com-

pany. New towers and condensers of the latest type will be installed, as well as new tankage, at Del Rio.

The Amarillo Producers and Refiners Corporation was organized in 1926. Since August 1, 1928, the company has been operating a 2000-barrel refinery at Pyote, Texas, running Winkler County crude. The capacity off that plant was recently increased to 3000 barrels per day, but only about 2000 barrels will be run daily until spring. Practically all of the gasoline made there is shipped to Chicago, Milwaukee, Detroit, Cleveland and surrounding territory.

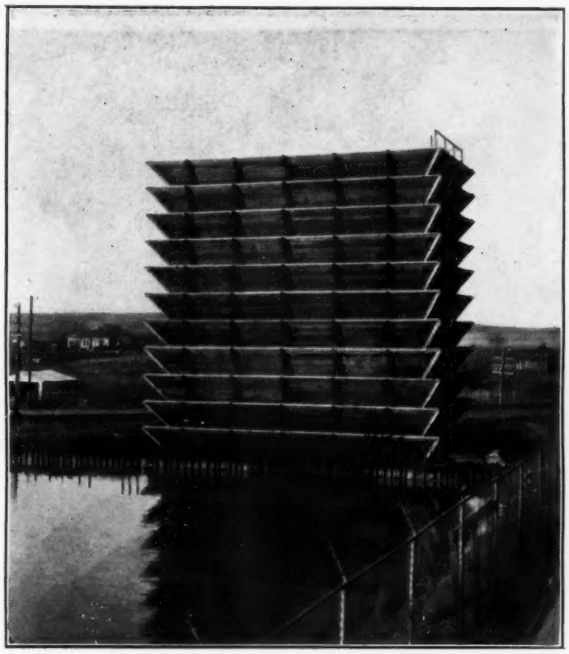
The company recently opened a branch sales and service office at Room 900, 624 South Michigan Boulevard, Chicago, in charge of T. F. Caldwell; the purpose of the new office being to better handle its present business and to increase the company's outlet in the Chicago territory. Mr. Caldwell is a man of many years of refinery and sales experience, and has been with the company for some time as assistant to P. H. Hertzog. Mr. Hertzog has been with the company since it began operating; as assistant to J. D. Wrather, and in charge of sales, traffic, and the office at Amarillo, Texas.

LA SALLE PETROLEUM COMPANY

Stockholders of Noble Oil & Gas Company, Tulsa, at the annual meeting held early in April voted that the assets of the company be transferred to the LaSalle Petroleum Company. The LaSalle company was organized to take over the Noble properties through an interchange of stock which will be effected as soon as possible. Change of ownership does not involve any changes in management. General offices of the company are in the Wright building, Tulsa. Noble Oil & Gas Company has been operating a 3,000 barrel skimming plant and a natural gasoline plant at Burkburnett, Texas, since 1917. The company is now installing a Jenkins cracking unit at its refinery. Charles F. Noble, for whom the company was named and former president, has not been connected with the company for several years.

RECOVERY PLANT

The Burrell-Mase Engineering Company, Pittsburgh, is building a gasoline vapor recovery plant for the Paragon Refining Company, at Toledo, Ohio, and is installing natural gasoline equipment for the Manufacturers Light & Heat Company, the Carnegie Natural Gas Company and the Equitable Gas Company, all of Pittsburgh, and for the Pennsylvania Gas Company of Warren, Pennsylvania Vapor recovery plants, which they recently built for the Pennzoil Company of Oil City, Pennsylvania, and the Raybestos Company of



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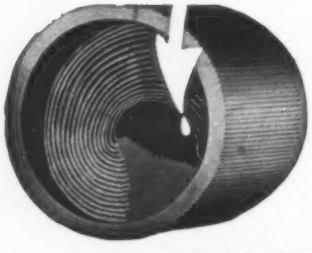

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Bridgeport, Connecticut, are now in full operation.

A new absorption plant was placed in operation April 12, by the State Gasoline Corporation at Long Beach. This will constitute No. 3 of its plants. It was erected at Elm and Columbia Streets by the J. A. Campbell Company of Campbell equipment.

Work on this plant, which was designed for 20,000 gallons per day, began March 15 and everything was ready for operation April 12.

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GROGAN PROMOTED

The promotion of M. J. Grogan to the presidency of the Louisiana Oil Refining Corporation, at Shreveport, was announced following a meeting of directors in New York, March 28, 1929. Mr. Grogan formerly was vice president and general manager. He succeeds R. B. Kahle, who resigned to devote full time to other interests. Mr. Grogan has been with the Louisiana Oil Refining Corporation several years, having joined the concern as sales manager.

PENNZOIL ENLARGING

The Rouseville, Pennsylvania, refineries of The Pennzoil Company are being enlarged through the installation of additional distillation equipment. A 4,000 barrel pipe still of latest design is now under construction. The company is also erecting a new 1,200 barrel vacuum type tube still for refining its steam cylinder stocks. Other improvements include four 325-plate, 48-inch filter presses, and a 400 horsepower water tube boiler. This is the second expansion program entered into at the company's two Rouseville plants within the last two years. L. D. Fulton is manager of refineries.

Phillip Stowel, formerly with the Utah Oil & Refining Company, Salt Lake City, has entered the employe of the Marland Oil Company as superintendent of the new grease plant recently completed at Ponca City.

The executive, accounting and sales departments of the Waverly Oil Works Company have been moved to 2050 Koppers building, Pittsburgh. This leaves the operating, purchasing, traffic and distribution departments at the old company headquarters building at the plant site, 54th street and A. V. Railroad.

Dr. E. H. Leslie, formerly professor of the engineering department of the University of Michigan, later with E. B. Badger and Sons Company, Boston, and lately of Smith & Leslie, Inc., Kansas City, Missouri, and Oil City, Pensylvania, has resigned his position as vice president and director of the Smith & Leslie organization. Dr. Leslie will engage in consulting engineering work in the refining industry, maintaining offices at Ann Arbor, Michigan, and Oil City Pennsylvania.

Union Oil Company is making several changes in its Wilmington refinery, near the Los Angeles harbor, and is adding a cracking unit to handle heavy oil. The company is also changing its oil treating plant and working over distillation furnaces where necessary. The additions and changes will necessitate additional tankage and shipping facilities. The total cost will be about $750,000.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of The Refiner and Natural Gasoline Manufacturer, published monthly at Houston, Texas, for April, 1929. State of Texas, County of Harris:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared R. L. Dudley who, having been duly sworn according to law, deposes and says that he is the Publisher of the Refiner and Natural Gasoline Manufacturer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: R. L. Dudley, P. O. Box 1307, Houston, Texas.

Editorial Director: S. W. Robinson, P. O. Box 1307, Houston, Texas.

Managing Editor: J. Kent Ridley, P. O. Box 1307, Houston, Texas.

Editor: Grady Triplett, P. O. Box 562, Tulsa, Oklahoma.

Business Manager: A. L. Burns, P. O. Box 1307, Houston, Texas.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

R. L. DUDLEY,
Publisher.

Sworn to and subscribed before me this 28th day of March, 1929.

(Seal) J. KENT RIDLEY.

(My commission expires June 30, 1929.)

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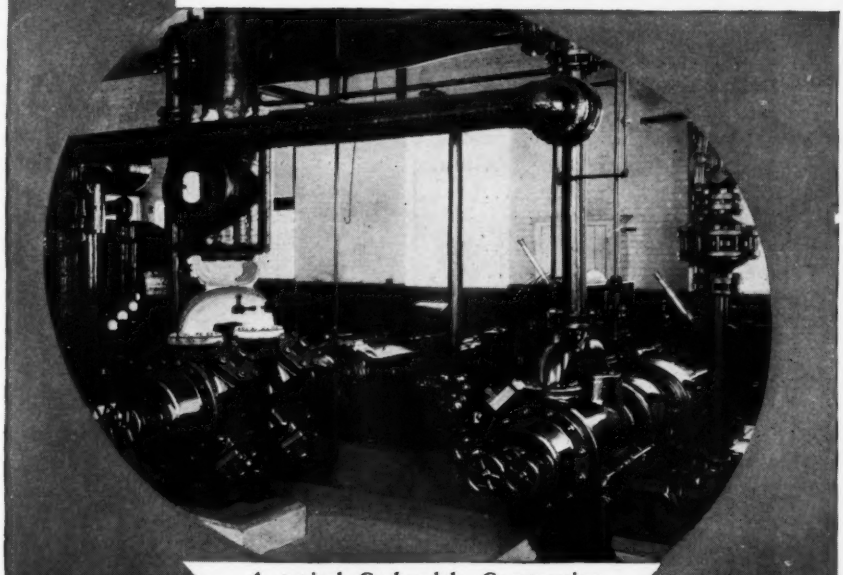

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ADVERTISERS INDEX

Agefci 144
Alfit Manufacturing Company...130
American Radiator Company.... 20
Amerada Petroleum Corporation 38
Armstrong Machine Works..... 53
Arrowhead Iron Works 145

Babcock & Wilcox Tube Co. 59
E. B. Badger & Sons Co. 4-5
Botfield Refractories Company.. 36
C. F. Braun & Company.....
.....Second Cover
Briggs & Turivas 162
Bristol Company .....42 and 108
G. G. Brockway Company 159
The Brown Instrument Co. 22
Byron Jackson Pump Manufacturing Company 9

Calorizing Company 66
Campbell Engineering Co. 157
J. A. Campbell Company 64
Carbondale Machine Company...161
Chaplin-Fulton Manufacturing Company 109
Chestnut & Smith Corporation...103
Chicago Bridge & Iron Works... 28
Clark Brothers Company 31
Cooling Tower Company 159
Cooper-Bessemer Corporation 128-129

Darling Valve & Manufacturing Company 51
DeLaval Steam Turbine Co. ...139
Denver Fire Clay Company 147
H. M. Detrich Company 25
J. P. Devine Manufacturing Company 142-143
Joseph Dixon Crucible Co.....41-158
E. I. Dupont de Nemours Co.... 68
The Duriron Company 140

Elliott Company 58
Empire Companies 147
Enduro Niostra Steel.....Insert
Engineering Research Equipment Company 131

Fisher Governor Company 60
Fluor Construction Company ... 45
Foster-Wheeler Corporation 62

The Foxboro Company 30

Garlock Packing Company 148
Goetze Gasket & Packing Co.... 40
Graver Corporation....Front Cover
Greene, Tweed & Company..... 63
Griscom-Russell Company 61

Hammond Iron Works 55
Harbison Walker Refractories Co. 162
Harrisburg Pipe & Pipe Bending Company 157
Heat Transfer Products Co..... 52
A. L. Henderer's Sons Co. 152
Hills-McCanna Company 21
Homestead Valve Manufacturing Company 23
B. Mifflin Hood Company 160
Hooker Electrochemical Company.117
Hope Engineering & Supply Co... 11

Interstate Color Company 161

Jackson Engineering & Equipment Company 45
Johns-Manville Corporation 29

M. W. Kellogg Company 50

Laclede-Christy Clay Products Company 27
Lagonda Manufacturing Co. ...151
C. H. Leach Company 65
Leeds & Northrup Company.... 33
Lincoln Electric Company 13
Lone Star Gas Company 145
Walter E. Lummus Company ... 26

Maintenance Engineering Corp...148
Matheison Alkali Works 32
A. Y. McDonald Manufacturing Company .....Fourth Cover
McMann Oil & Gas Company.... 38
Meriam Company 111
Merco-Nordstrum Valve Co. ...141
Metallo Gasket Company 154
Metalistic, Inc. 148
Metric Metal Works 110
Midwest Piping & Supply Co. 132-133
Mine Safety Appliance Co. 160
Mixing Equipment Company ...139

National Airoil Burner Co. 54
National Meter Company 40
National Transit Pump & Machine Company 124-125
National Tube Company 49
Neilan, Schumacher & Company. 3
New Jersey Asbestos Company.153
North American Car Corp. 47

Oakite Products, Incorporated...151
Ohio Steel Foundry Company...
.....Third Cover
Oil Conservation Engineering Co. 44

Pacific Copper & Brass Works...121
Petroleum Iron Works 17
Phillips Petroleum Company 10
Pittsburgh Pipe Coil & Bending Company 154
Pittsburgh Steel Products Co. ... 14
Power Piping Company 158
Pulmosan Safety Equipment Corporation 138

Reading Iron Company 43
Refinery Supply Company 138
Roto Company 39
Rubshell-Texas Company 150

Sarco Company 134
Schutte & Koerting Company.... 39
Skelly Oil Company 15
Smith Engineering Company 12
A. O. Smith Corporation ...136-137
Southwestern Engineering Corp.. 19
Stockham Pipe & Fittings Co. .. 57
Sun Company 104
Sun Ship Building and Dry Dock Company 8

C. J. Tagliabue Manufacturing Company 18
Taylor Instrument Company 127
Texas Fire Brick Manufacturers Association 135
Tube Turns, Inc. 56
Tulsa Boiler & Machinery Co. .. 34

Universal Oil Products Co. 123

Henry Vogt Machine Co. 6-7

Ward Chemical Company 146
Walworth Company 37
Westcott & Gries 107
C. H. Wheeler Manufacturing Company 48
Wilkinson Controller Company..152
Williams, Brown & Earl, Inc...162
Winkler & Koch Engineering Co. 16
Wyatt Metal & Boiler Works ... 24

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